THE

ELECTRICAL REVIEW.

VOL. XXXIII. OCTOBER 27, 1893. No. 831

CONTENTS:

	PAGE
Thunderstorms	435
The Elieson Storage Battery System in Operation (*illustrated*)	438
The Scientific Study of Arc Lamps.—II. (*illustrated*)	439
The Maximum Efficiency of Arc Lamps with Constant Watts (*illustrated*)	441
Modern Gas and Oil Engines	441
The Leroy High Tension Cut-out (*illustrated*)	442
A New Electricity Meter (*illustrated*)	443
The New System of Alternating Current and Transformer Distribution	444
The Return Circuit for Electric Railways	445
On the Chloride Electrical Storage Battery	445
Review:—Electric Light and Power Distribution.—III.	446
Correspondence:—Megohms: Limited or Unlimited	446
Electrical Education.—What is Lithanode?	447
City and Guilds Examination	447
Jerry Wiring.—Water Power	448
Electrolysis: An Enquiry	448
Information Wanted *re* Pumping by Electricity	448
Lightning Express Railway Service	448
Notes	448
Contracts Open and Closed	453
Business Notices	454
City Notes:—Brighton and Hove Electric Light Company	455
Montevideo Telephone Company	455
Eastern Extension Telegraph Company	455
Traffic Receipts	455
Share List of Electrical Companies	456
The Development and Transmission of Power from Central Stations.—IV.	457
American Electro-Therapeutic Association	458
A Recording Tachometer for Central Stations	460
The Anglo-American Telegraph Company	461
New Patents	461
Abstracts of Published Specifications	461

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).
ORDER AT ONCE

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

FOR THE 1894 ISSUE.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of commercial Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address "AGREKAY, LONDON." Code A B C. Telephone No. 517.
ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.
ADVERTISEMENT RATES ON APPLICATION.
The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 6d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Phillipine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 8s. 10d.
BINDING.—Subscribers' numbers bound, including case, for 3s. 6d. each volume.
CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.
READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.
FOREIGN AGENTS.—*New York*: D. VAN NOSTRAND, 23, Murray Street. *Paris*: VEUVE J. BONVEAU, 22, Rue de la Banque. *Berlin*: ASHER & Co., 5, Unter den Linden.
Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 22, Paternoster Row, E.C.

THUNDERSTORMS.

VARIOUS hypotheses have been advanced to explain the action of thunderstorms, but the best of them account for only a small proportion of the facts. The origin of the electric charge in the thundercloud has been ascribed to evaporation or condensation of water; but laboratory experiments lend little support to this view, for no trace of electricity has been found in connection with evaporation or condensation, except when accompanied by strong mechanical actions, which, in themselves, would sufficiently account for the development of electricity. Other explanations are, that the charge may be due to the formation of hailstones, or to the coalescence of small drops of moisture to form larger drops. In this latter case an exceedingly small charge of low tension on a tiny particle of moisture might have its tension raised to the potential of the lightning flash by coalescing with similar particles to form a large raindrop, as the surface of the drop does not increase in proportion to the charge. An objection to this theory, however, is that the similar electric charges on the particles of moisture would cause repulsion between them, and oppose the coalescence.

One of the best explanations offered is that the electric charge is due to the friction between two currents of air which differ in temperature or in hygrometric condition. Before a great thunderstorm the lower air is usually at an abnormally high temperature, and fully saturated with watery vapour. These unstable conditions tend to produce a vertical current of moist and hot air, which, by friction with drier and colder surrounding air, would produce an electric charge which would be absorbed by the particles of moisture condensed as the moist air rises into colder and rarer regions.

The origin of thunderstorms is not likely to be completely ascertained until observations are undertaken on a large scale, at national expense; but the operation of a storm may, in many cases, come within the view of a single observer. While travelling recently in the undulating lowland lying in the north-east corner of Scotland, we had an unusually favourable opportunity of observing the *modus operandi* of a thunderstorm from start to finish. The undulating lowland district in question is bounded on the south and west by a rampart of mountains, with peaks rising in places to heights varying from 1,700 to 1,900 feet, and on the north and east by the sea. Near the northern and eastern boundaries are ridges of low hills, of which the maximum height is less than 800 feet. In shape and size the district may be looked upon as approximately a square of about 20 miles a side.

Just before the outbreak of the storm one could see from a position near the centre, a dark cloud covering the whole of the south-west half of the square, while the north-east section had a comparatively clear and cloudless sky. The southern edge of the cloud had a characteristically jagged outline, which could be seen slowly approaching the mountains. At

one point a dark hazy band, stretching from the cloud to the earth, showed that a heavy discharge of rain had there begun to fall.

Very soon there was a flash of lightning. The electric discharge could be seen passing from the descending cloud to the mountain peaks. The local discharge of rain evidently increased, but the strangest thing which happened was this: The cloud with the jagged edge which before the discharge had been seen slowly approaching the mountain, immediately after the discharge began rapidly to ascend. The storm now quickly developed itself. At intervals of a few minutes flashes could be seen passing from other parts of the southern and western edges of the cloud to the earth. Then horizontal flashes began to pass from one cloud to another. By estimating the time interval between the flash and the thunderclap, it was found that the discharges were approaching by steps varying from two to three miles in length. The heavy discharge of rain advanced *pari passu* with the electric discharges in a north-east direction, and soon the whole of the south-western half of the district was under a heavy shower of rain.

The north-eastern part of the sky, which at the commencement of the storm had been cloudless, had during the progress of the storm become gradually overcast, and through this newly-formed cloud the lightning discharges, with their accompanying showers, continued to advance. Some vertical discharges from the eastern and northern boundaries of the cloud were seen to pass to the highest points of the ridges lying along the sea coast; and very soon after the storm ceased.

The leading phenomena in this thunderstorm appear to admit of simple explanation. Let us assume that the dark thundercloud, before the storm, is charged with one kind of electricity, and that like all clouds which are formed by the friction of air currents, it consisted, according to Helmholtz theory, of parallel banks of cloud separated by insulating air spaces. Each of these constituent banks of cloud would have its charge of electricity distributed over its surface. The cloud nearest the high mountain rampart on the southern boundary would be first attracted, the attraction would produce a coalescence of the watery particles, and consequently a rainfall, and finally, when the cloud had approached sufficiently near, a discharge of lightning to the earth. This cloud would be now almost neutral, and whereas before the discharge it moved slowly towards the earth under the opposing attractions of the earth charge and the charges in thunderclouds behind it, after the discharge the attraction of the earth would be annulled, and the unopposed attraction of the undischarged clouds would cause it to rise at a more rapid rate. This, as we have stated, is exactly what happened.

It is easy to follow out on this hypothesis the further progress of the storm. The neutral cloud will approach a charged cloud till another discharge takes place, accompanied by another discharge of rain, and thus the discharges between clouds and rainfalls will pass through the whole of the thundercloud till it reaches the opposite boundary, where residual charges of electricity which may have accumulated will pass to the earth.

Two-Phase Systems.

A few articles on this subject will, no doubt, interest many readers. It has never before been simply treated as a whole; and, as the system is being adopted at Niagara Falls and bids fair to become a powerful rival to the existing systems, many people are eager to know just what a two-phase system is, and how it will be worked, and what advantages will be derived from its adoption. They will, we believe, get some assistance and insight from the series of articles which are commenced in this issue.

Pollak's Method of Rectifying Alternating Currents.

This much talked of invention is really of very little importance. Commutating alternating currents into unidirection pulsating currents by means of a commutator driven by a synchronous motor is a very old method, and well known now. Pollak's improvements consist simply in cutting off connection from the commutator before the electric pressure wave falls below a given pressure, and making connection again when the pressure wave rises to the given pressure; thus a storage battery may be charged, the connection being on only during the period when the pressure exceeds the pressure of the battery. Such a device requires too much skilled attention, and is far too complicated ever to be of any practical value; besides, there are better plans for utilising storage batteries in a distribution system by alternating currents.

A Piezo-electric Pile an Accidental Travesty.

From a theoretical point of view, one of the most interesting papers read before Section A of the British Association at the recent meeting at Nottingham was Lord Kelvin's note on a piezo-electric pile. It is remarkable, however, that no one remembered that the ground had been traversed before by MM. J. and P. Curie, whose communication to the Paris Academy of Science on February 14th, 1881, describes precisely the same combination as that described by Lord Kelvin, and shows the application of the principle illustrated by it to explain all the piezo-electric and pyro-electric properties of crystals. Lord Kelvin has himself unearthed this paper, and, in a note to the October issue of the *Philosophical Magazine*, he states that it interests him exceedingly to find that they (MM. Curie) have also given, what seems to him, undoubtedly, the true electro-molecular theory of the constitution of crystals, explaining not only piezo-electricity but the old-known pyro-electricity; and bringing these properties into relation with the electro-chemical constitution of the crystalline molecule. Thus we have another, and particularly remarkable, instance of different minds independently aiming at the same conclusion, or making the same "discovery." *Inter alia*, the circumstance may well form an argument for the better, and more up-to-date, indexing of the proceedings of scientific societies. With an ideal system of indexing, and assuming that every worker in any field of research will "look up" all the references, the event of such overlapping of results cannot be conceived as at all likely to happen.

Tuberculosis Treated by Ozone.

At a sitting of the Académie de Médicine at Paris recently, M. Hérard read an extremely interesting report on the treatment of tuberculosis by the inhalation of ozone, which Drs. Labbé and Oudin recommend and have successfully applied. It appears from this report that the action of ozone is especially beneficial to those who suffer from tuberculosis. Appetite reappears, perspiration ceases to weaken the patient, the

blood becomes richer in oxyhæmoglobin, and the respiratory organs become more active. Numerous consumptive subjects who have been since two years either completely cured by Drs. Labbé and Oudin, or are at least in a much better state of health, show that the treatment by ozone presents some undeniable advantages.

Commercial Magnetism.

Under the significant initials "J. S.," our contemporary, *Industries and Iron*, publishes a series of articles on "Commercial Magnetism" which are excellent reading and easily comprehended, and leave little doubt in the mind that "J. S." is neither "John Smith" nor "Jack Shepherd," but an esteemed writer who is much at home with this phase of his subject, as with Hedgehog transformers, and vexed points in electrolysis. The first article establishes some parallelisms and differences which subsist between the laws of magnetism, electricity, and statics, and gives a fair conception of the unit magnetic pole, described so faithfully that it appears before us now, bristling with its 4π lines like a calcareous rhizopod, and we classify it as a perfect specimen of *globigerina bulloides*, subservient to the universal spirit of inverse squares. The conception of magnetic potential is confessedly a little more difficult to establish by simple analogies than is a magnetic pole. But "J. S." has the dodge of it, and cleverly works it out along the same lines; and, in passing, gives the idea of "current," "work," and "power." Blinking, for the time being, at the notion of "resistance," he tells us, straight away, that "unit E.M.F. is defined as the E.M.F. which gives unit power with unit current." The magnetic rhizopod with its 4π rays is then made to float around a unit current loop, and it is shown that if all the 4π lines cut the loop in a second, and cut it uniformly, there is a back E.M.F. of 4π units developed, and as this is maintained for one second, there are 4π units of work done. If the rhizopod floated more slowly around its looped path the E.M.F. would be less, but the cycle would take longer to complete, so that the work done would be the same. The work done when the current is constant is thus proportional to the number of lines by which the loop has been cut, and is independent of the time; the magnetic rhizopod thus does 4π units of work when it floats round any circuit interlinked with a loop of wire carrying a unit current, no matter by what path it completes the cycle. Or, in the language of commercial magnetics: the work done by a pole in such a case is $0{\cdot}4\pi$ times the ampère-turns in the loop or exciting circuit; the ampère being one-tenth of the C.G.S. unit of current. Reverting once more to statics for a definition, "electric force" is shown to be measured by the rate of decrease of potential, the notion of "acceleration" being kept behind the scenes. "Magnetic force" is similarly defined, and the two are carefully distinguished from the terms "electromotive force" and "magneto-motive force," which latter are apt to clash with the truer meaning of electric or magnetic force, and are, therefore, to be strongly censured, if not altogether condemned. The analogy between magnetic and electrical circuits has next to be traced, and here "J. S." finds it necessary to distinguish between the condition of current and the condition of mere electric stress, and then to determine whether the magnetic circuit is analogous to the current-carrying electric circuit, or to the case in which there is no current; or, again, whether it also has two states, and thus corresponds accurately with the electric circuit. These significant distinctions and differences are very happily stated, and we shall follow with much interest the whole of the series. It would be convenient for reference if the articles were consecutively numbered. So far we are not quite certain where the "commercial" commences; we hope, not soon.

The Lamp Situation in America.

Legal warfare and competition in connection with incandescent lamps has by no means ceased in the United States since the hearing of the Oconto case. Three motions for a preliminary injunction have recently been heard before Judge Lacombe at New York, the suits having being brought by the Edison Electric Light Company and the Edison Illuminating Company, against the Morris Electric Light Company and the United States Electric Light and Power Company. These cases differ from most of the preceding in that the defendant companies are users of lamps and not lamp manufacturers. Nothing of a very novel nature seems to have been brought up during the hearing, the principal line of argument being that the defendants went into business at a time when conflicting legal decisions were being given in foreign countries, and when it was quite a problem whether the lamp patent could really be sustained. The Court recognised three classes of infringers; first, manufacturing concerns and competitors of the Edison Company, who entered business with a knowledge of the risks they were running; secondly, those who had supplied themselves with apparatus and lamps from infringers prior to the decision of the Central Court, and when the validity of the patent was much questioned, but who were now willing to accept their lamps from complainants; and thirdly, those users of plants which have been acquired subsequent to the decision of the Central Court. Of these, the second class would naturally be treated with the greatest leniency, and it is under this class that the defendants hold themselves to be. The Court, however, held that they came rather under the first category, and that the second merely included the unskilled and unsuspecting public who had no knowledge of electricity, patents, or litigation as to inventions, and who bought articles in the open market. The Court was aware that great pecuniary interests were at stake, and that whichever way the decision was made considerable financial loss must ensue. The equities on both sides were very strong, and it was the duty of the Court, where the balance was so equal, to decide in favour of the patentee and licensee. Hence the injunctions would be granted. It is also stated that the Appeal in the Oconto lamp suit is to be brought on very shortly. This step is being undertaken by two or three powerful organisations who have large interests at stake, and who are very confident of success. But whether the issue is successful or not is not considered to be a very vital matter to some competing manufacturers, as they are becoming licensees of the Beacon Lamp Company, whose new cement lamp we commented on a week or two ago. From all accounts this lamp promises to successfully tide over the interval during which the Edison patent lasts. This result would not be likely to ensue if European lamp prices were ruling in the States, but with lamps at two shillings or more each we see nothing to damp the hopes of the manufacturers as far as cost of manufacture is concerned. We do think, however, that it is perhaps a little premature at present to pronounce too decidedly that these lamps will prove thoroughly satisfactory in commercial use. The accounts of the behaviour of the Westinghouse stopper lamp in practice is not entirely favourable. The number turned out is said to be comparatively inconsiderable, whilst the average life of the lamps is put down at about 250 hours, and this at no remarkable degree of brilliancy. It is well, therefore, not to be too sanguine about the thorough success of lamps in which cement takes a part. We further understand that the final hearing of the Columbia case, and the Goebel story on which it rests, has not, by any means, been dropped, and, in due course, it may be expected to come on for hearing. It will be interesting to learn the truth of the matter.

THE ELIESON STORAGE BATTERY SYSTEM IN OPERATION.

We recently referred to the successful working of Mr. Elieson's battery system in the town of Mount Vernon, N.Y. The following will enable our readers to appreciate some of the difficulties that Mr. Elieson met with in his experiments. The system has been working since July 31st. The road is unique in more than one respect. In the first place the track, two miles long, is laid directly on the surface of a country road, with no attempt at grading, and it does not contain 25 feet on a level from one end to the other, while the curves are more numerous than the stretches. It may be interesting to follow the course from start to finish, remembering that, in addition to its other peculiarities, the rails are not aligned very well, and that the track is usually partly covered with either dust or mud according to the state of the weather.

Two 37-Foot Curves

Starting from the New York and New Haven Railroad station, the eastern terminus, there is first a down grade of 3 per cent. (the word "grade" being used by courtesy), for about 400 yards, at the end of which is a curve at right angles with a 37-foot radius on an up grade of 3½ per cent.; this grade continues for the length of a city block, curves again at right angles, with the same radius as before, continues for about 60 yards in a straight line and makes another curve with a radius of 60 feet. The wheel-base of the car, by the way, is 6½ feet. From this point the road is straight for about half a mile and has an upward grade varying from 3 to 4 per cent. Passing the top of this hill

Ascending a Long Grade.

the road takes a dip of 200 yards on a 6½ per cent. grade and immediately starts up again at 4 per cent. around a curve of 45 feet radius; up a short stretch of straight track and another curve with a 3 per cent. grade; then another stretch where the track is more nearly level, but not so much as to prevent the car from coasting along it on the return trips; two more curves, right and left, the second on a short, sharp grade, and, finally, a longer straight bit of road on which the grade ranges from 1 to 3 per cent.

The rolling stock consists at present of one car only, for the road is an experimental one, so far as the Mount Vernon company and town authorities are concerned, though the system upon which it is run has passed considerably beyond the experimental stage, and Mr. Elieson purposely selected a route possessing as many disadvantageous points as possible to show just what his accumulators could do if the occasion demanded.

It is not very long ago that we described Mr. Elieson's cell, which, as our readers will remember, is made on the Planté principle, the electrodes being built up of corrugated and perforated envelopes of thin lead which present a large surface.

The equipment of the car consists of 200 of these cells, normally connected in parallel but so controlled from the starting box that, on steep grades, or other places where more power is needed, they may be joined in series; and one 7 H.P. Thomson-Houston motor wound for 250 volts and 20 ampères. A Stephenson truck formerly used on the Fourth Avenue road in New York, with two Thomson-Houston motors, was secured and one motor discarded entirely; the other was then rewound to suit the present conditions and is doing the work alone. As a matter of fact, in ascending the 6½ per cent. grade not less than 15 mechanical horse-power is frequently developed. The accumulators are placed under the seats and beneath the body of the car, and are never removed for charging. Instead, at the end of each six miles run, the car enters the power house and the batteries are charged for about ten minutes, when work is resumed for another six miles.

The diagram on the next page shows the construction of the controlling switch. In the position shown, all the circuits are open. On revolving the handle to the right the batteries are connected in parallel to the motor through resistance which is all cut out gradually in the first quarter revolution. The circuit is then momentarily broken and the batteries are connected in series to the motor through the same resistance as before, which is again cut out during the second quarter revolution. A stop prevents the connecting bars from revolving further, while lugs on the handle, which can only pass through corresponding notches on the lid, prevent it from being withdrawn, except when the current is quite cut off from the motor.

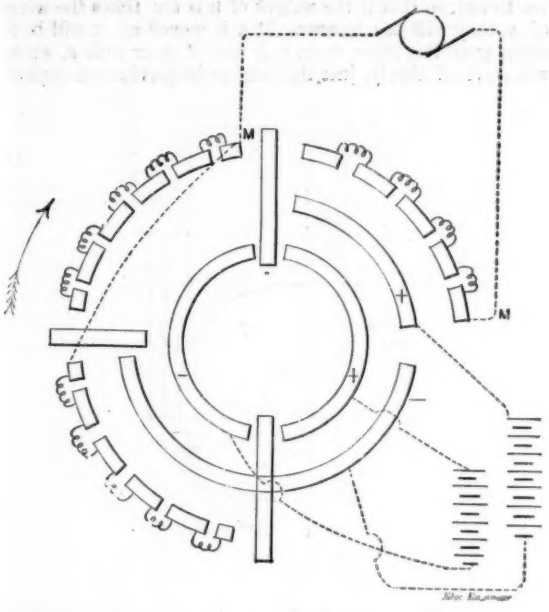
On the regular trips the car makes from 4 to 7 miles an hour on up grades, while on the comparatively level parts of the road a speed of 12 miles an hour is attained, and about 44 miles a day are covered. On one of the regular trips recently some readings were taken on voltmeter and ammeter, both Weston instruments, that are exceedingly interesting. They are shown in the following table:—

Remarks.	Grade per cent.	Ampères.	Volts.	Battery connections.
Start	3	16	190	Parallel
Curve	3½	30	180	"
Straight track	3½	25	176	"
Curve	3½	40	172	"
Long, straight track ...	3 to 4½	40	170	"
" " " ...	"	38	170	"
" " " ...	"	39	168	"
" " " ...	"	39½	168	"
" " " ...	"	36	170	"
Start from state of rest ...	4½	80*	170	"
Long, straight track ...	3 to 4½	33	170	"
" " " ...	"	42	166	"
" " " ...	"	30	315	Series
Curve	4	36	168	Parallel
"	3½	34	290	Series
Straight track	2½	28	170	Parallel
Long hill on back trip ...	6½	40	280	Series
Readings about every half minute	"	45	250	"
	"	50	230	"
	"	50	230	"
	"	55	230	"
	"	55	230	"
	"	45	250	"
	"	40	280	"

* Momentary swing of needle. Immediately dropped to 33.

The power-house, consisting of two little rooms connecting with the car barn, contains a 50 H.P. boiler and engine built by E. P. Hampson, of this city, the latter belted to a 40 kilowatt Dallett generator wound for 550 volts and 70 ampères. As was mentioned above, the car runs into the

barn at intervals so that the batteries may be recharged, but it is intended soon to lay a cable to the depôt end of the line and recharge while the car waits between trips, so as to avoid loss of time.



The car (as before stated) has been running since the latter part of July without a hitch of any sort, and has more than satisfied the expectations of the townspeople and even, in view of the condition of the road bed, the inventor himself. Another car will soon be added. Assisting Mr. Elieson, and superintending the construction and operation of the batteries, is Mr. E. J. Wade, who was for a long time in charge of one of the charging stations for launches on the Thames, and hence is peculiarly qualified for this class of work. Mr. Elieson hopes, now that his little road is a complete success, to interest larger companies in his system and introduce it extensively in America.

We are indebted to the *Electrical Engineer*, of New York, for the foregoing details, and to the Editors of that journal for the loan of the blocks.

THE SCIENTIFIC STUDY OF ARC LAMPS.

By RANKIN KENNEDY.

II.—The Rack and Pinion Motion.

This motion is used in arc lamps, perhaps more than any other of the mechanical devices. All the successful arc lamps in the days before the dynamo, about twenty years ago, were rack and pinion lamps; the old Serrin lamps and Foucault focussing lamp had rack and pinion motions.

The rack and pinion must always be combined with a stop motion in some form or other; the commonest stop motion consists of a train of wheels, the last wheel being very easily stopped by a detent or friction brake.

The intermediate train of wheels multiplies the inertia of the fly, F, in fig. 6, which also acts as the detent wheel and causes the descent of the rod, R, to be very slow and gradual; the rod, R, in falling, has to set in motion the whole train, and therefore starts off slowly, so that it is evidently quite easy to regulate the feed downwards of the rod, R, which carries the carbons by stopping the fly, F, with a finger; by letting F go it would start off slowly, gradually increasing in speed, but as F makes, say, 100 turns for one turn of the large wheel in gear with the rack on the rod, R, there will be plenty of time to watch the feed downwards of the rod, and to stop it by the finger on F before the feed has gone too far. The whole object of the intermediate train of wheels is to cause the fall of the rod, R, to take time in its movement; and the train of wheels also multiplies the force applied to the fly, F, to stop the motion. Although the rod may be heavy, yet a very small force applied at F will stop its downward motion; the train multiplies the force by 100. In all rack and pinion arc lamp motions we find this

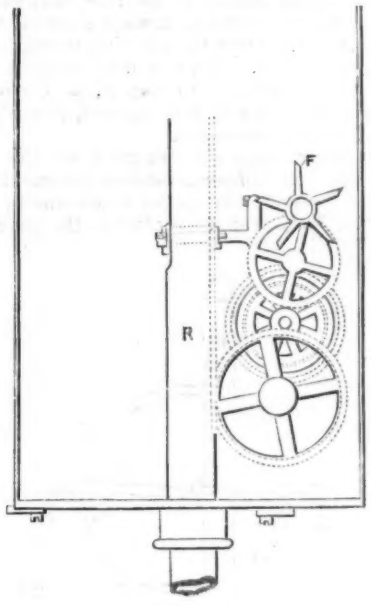


Fig. 6

multiplying of the force applied to stop the feed, and we also find the time of the feed motion is slowed down by the same means. Fig. 6 is a diagram of a train of wheels, arc lamp motion, geared to a rack on the carbon rod holder, R. Many lamps in practice are operated in this way.

Engineers very soon discarded the train of wheels and the fly. The fly was first discarded and replaced by a smooth pulley on which pressed a very light brake, so that by varying the pressure of this brake the speed of the smooth wheel could be regulated.

Then the intermediate gear was abolished, and the smooth brake pulley fixed directly on to the pinion gearing into the rack. Fig. 7 shows a lamp motion of this

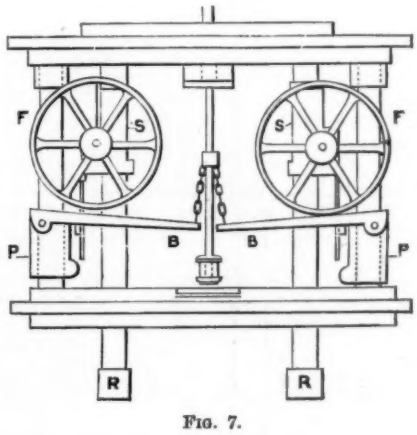


Fig. 7.

kind. R R, are the rods carrying carbons; F F, are the wheels fixed on the pinions, which gear into racks on the rods, R R. The wheels, F F, and pinions are carried in bearings in sleeves, S S, through which the rods can slide freely and drive round the wheels when the brake levers, B B, are down out of touch with the wheels. On lifting the levers the wheels are stopped and the rods consequently held stationary; by lifting still further the wheels, sleeves, rods, and all can be bodily moved upwards. On lowering the levers until the sleeves, S S, come into contact with a fixed

stop so that they cannot fall any longer, the further lowering of the levers will release the wheels and let the rods slide through, driving the wheels round. Now, the wheels are large in diameter and the pinions small in diameter, possibly in the ratio of ten to one to each other, and the wheels have considerable inertia, which multiplied by ten gives a force resisting the rapid motion of the rods downwards. When the brake releases a wheel, that wheel starts off very slowly, due to its inertia, so that there is time to stop it before the feed has gone too far, and a very light pressure of the lever on the wheel is sufficient to stop it, as the force of the driving weight, which is here the rod, is reduced by the pinion and wheel to one-tenth.

A great many lamps are now made on this mechanical principle, the chief difference between the one and the other lying in the form of brake applied to the wheels, F F.

In fig. 8 a brake is shown applied to the inner rim of the

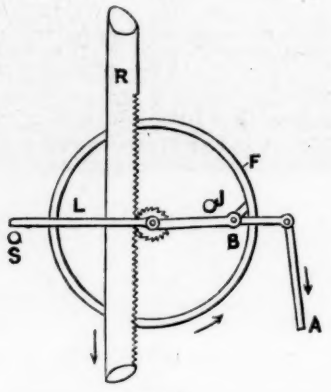


Fig. 8.

wheel; the brake, B, is nothing more nor less than the old fashioned nipper or friction brake. Any ordinary mechanician can at once see numerous forms of friction brakes by which to seize and slip the wheel on the inside. L, is a lever moving on the same centre as the pinion; the pinion and wheel, F, are on the same spindle and move together. On pulling down the wire, A, the brake point, B, would nip the wheel and pull it round, lifting rod, R, and the tail of lever, L, from stop stud, S. On pushing A up, the wheel would be turned round and the rod fed down until lever, L, touched stop, S.

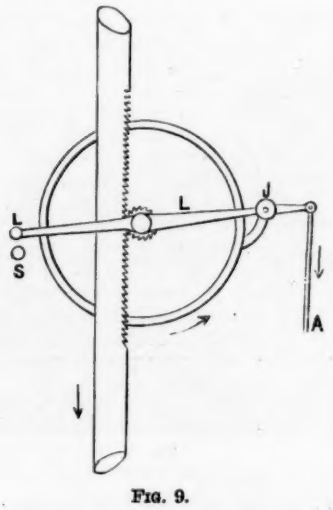


Fig. 9.

Any further push up on A would release the brake, B, and allow the wheel to move and the rod to feed down again; this feed could be instantly stopped by a slight pull down on wire, A. It will be seen that the multiplying by the pinion and wheel acts just as it did in our previous example, and that it takes time to set up rapid motion on the large wheel driven by the pinion, and, therefore, before the rod has dropped far it can be stopped easily at B.

Fig. 9 shows the same gear with the brake applied to the outside of the wheel.

Fig. 10 shows another form of brake. Here the wheel, F, has teeth cut on its periphery, and is geared into a short movable rack, B; the ratio of the wheel and pinion may be ten to one, so that if the weight of R is ten times the weight of A, they will just balance. If A is moved up, R will be fed down until the short rack, B, is out of gear with F, when F will start off slowly, just the same as in previous examples of

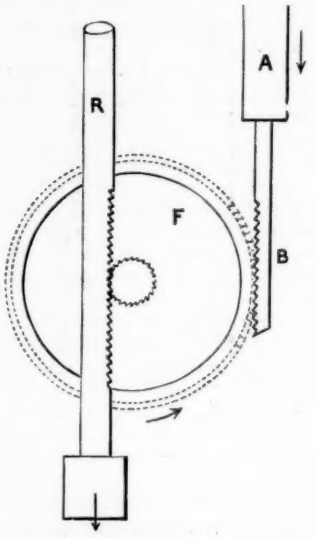


Fig. 10.

the rack and pinion motion, and the slightest motion of A downwards will instantly stop the feed.

Several methods of disengaging and re-engaging the rack, B, are quite obvious to mechanicians.

Another mechanical device for working the brake consists of a cord or strap, weighted at one end and passed over a smooth wheel, F. If we pull down on weight, W', rod R will

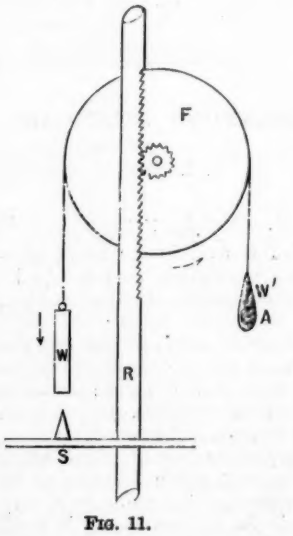


Fig. 11.

be raised; if we raise A until weight, W, comes down on stop, S, the further raising of A would slack off the strap or cord and let the wheel, F, move round and feed down the rod, R, as shown in fig. 11. Here, again, any mechanic will be able to devise numerous ways of applying a cord or strap brake to the wheel, F, so that it can grip or release on pulling and pushing at A.

In fig. 12 a rack chain is shown substituted for the rack on the rod, R; the brake is a lever brake, as already shown. A

push or a pull at A will grip or release B'. R' is slightly heavier than R, so that on releasing the brake, R' descends; the rack chain, C, is guided over pulley and gears into the pinion, P.

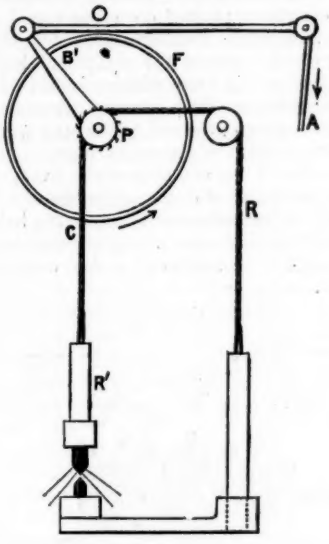


FIG. 12.

In any rack and pinion lamp whatever, this rack chain may be substituted for the rack rod, and it will not require much mechanical skill to see how to apply it to the various gears already shown.

FIG. 13.

Fig. 13 shows a rack chain gear, the chain being full size suitable for lamp work.

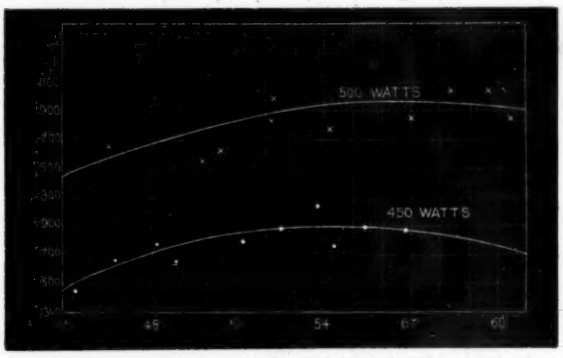
THE MAXIMUM EFFICIENCY OF ARC LAMPS WITH CONSTANT WATTS.

PROF. CARHART has published some interesting curves of efficiency of arcs with constant watts, and the results show clearly the important fact that with constant watts in an arc we may obtain very different candle-powers by varying the current and pressure inversely, still keeping the watts constant.

The fig. contains two curves derived from the data obtained by the professor's experiments with constants of 450 and 500 watts. Both show a maximum at 54 and 55 volts respectively; hence, for a lamp of 450 watts the current should be about 8·4 ampères, the candle-power is then 900. At 10 ampères and 45 volts this curve shows the surprising fact that the candle-power was only 450. The 500-watt arc gives most light, namely 950 candles, with 9 ampères and 55 volts, while with 45 volts and a little over 11 ampères, it gives only 500 candles.

Now, we are aware that the facts here disclosed are well known to practical electricians engaged in arc lamp work; but, unfortunately, arc lamps require to be made to suit the available circuits in this country. They cannot command the voltage of the circuits to suit their lamps; the consequence is that most lamps working on the usual 110 or 100-volt circuits are working at low efficiency with 10 ampères.

There is no remedy for this state of affairs on the continuous current low pressure circuits supplying the public. The fact is, the advisers of those who have adopted that system of supply fixed upon the pressure most suitable for Edison-Swan incandescent lamps; anything else seems never to have been considered at all. We do not reflect in the slightest upon arc lamp designers or makers when we say that the amount of light given by most arc lamps could be increased by at least 25 per cent. on circuits supplying 100 volts or 110 volts, and that without any more power being used, simply by raising the pressure and decreasing the



current. Contractors and others who are free to adopt suitable pressures in any arc lamp schemes would do well to look into this question, and remember that the 45-volt 10-ampère lamp is a creation to meet the 100 or 110 volts public supply circuits, quite regardless of efficiency or inefficiency. Two of them must be run in series with some resistance for regulation purposes, hence 45 volts is all that can be allowed for the arc.

In alternating current supplies, no difficulty ought to exist at all; in that case the pressure can be varied as you please, so that the pressure can be adjusted to suit the lamp and give the maximum efficiency.

There are some peculiarities connected with alternating arcs not generally known, to which reference may be made again in our columns.

MODERN GAS AND OIL ENGINES.

THE continuation of Mr. Spies's papers in *Cassier's Magazine* contains an allusion to the frequent neglect of the consumption of gas by the ignition burner, which may reach an appreciable amount. The difficulty with oil engines has stimulated the improvement of electric igniting devices, against which has to be set the expense of the battery, but this is of very small account, and electric lighters are destined to grow in favour. Not less important is the governing of the gas engine. The throttling of the gas supply is condemned as wasteful, for it may lead to non-explosive strokes, and the gas is wholly lost, being simply pumped through the cylinder. With the hit and miss device the explosive mixture is always uniform, but irregular running is apt to be caused, and some makers have made a stepped hit and miss device which acts like a throttle up to, but not beyond, the limit of explosive mixture, and then shuts off the supply entirely.

The ideal method of governing would be one where the mixture would be of uniform quality, and only vary in quantity. This is said to be effected in the Pittsburgh gas engine, a two-cylinder vertical type, of which there are not sufficient particulars to hand for full description, and we are not informed how the rate of compression is maintained constant in face of a varying admission of gas, &c. This engine uses the electric spark igniter, and the explosive mixture is measured out by a measuring piston valve.

The Charter engine brings us to the end of the list, which, voluminous as it has turned out to be, is by no means complete, some makers flatly refusing any particulars, others ignoring the request for particulars.

The Charter engine uses gasoline if required, and the oil is delivered direct to the suction pipe a few drops at a time.

The Otto cycle is adhered to, and this engine has been made up to 35 horse-power.

Only engines of English or American make have been noticed in the series, except such foreign ones as are represented in the English and American markets. The gas engine is nearly as numerous in its many forms as the steam engine, but no doubt will pass through the process of natural selection—indeed seems to be doing so already—and we shall finally have probably a single type with but few variants.

To round off our notice of this series, we might call attention to our own illustration (Electrical Review, October 6th, 1893), of the new three cylinder inverted type of gas engine now being made by Messrs. Weyman and Hitchcock, of Guildford. This engine presents a neat and very simple appearance, and is well worth study.

THE LEROY HIGH TENSION CUT-OUT.

Being entrusted with the management of Messrs. Poilpré and Co.'s works (M. Leroy in *Revue Internationale de l'Electricité*), I had recently occasion to design a cut-out, which gave such excellent results, and was based on such a novel idea, that I think it will be worth while to give a description of it.

The apparatus consists in principle of a small dynamo with bipolar inductors, of the type known as "superior," the armature, which is suspended between two points, resembles in form the first Siemens armature with an H-shaped iron core. The two vertical cores of the inductors are wound with different sizes of wire; the winding of the one on the left of the figure is formed of a wire with sufficient section to carry, without any abnormal heating, the maximum current; the wire of the right hand bobbin, on the other hand, is calculated according to the maximum difference of potential of the battery, so as on the one hand not to get heated, and on the other, only to allow a weak current to pass.

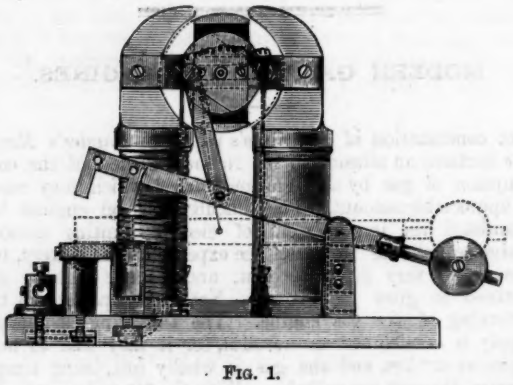


Fig. 1.

The thick wire circuit terminates at one extremity at one of the terminals of the instrument, and at the other in an iron cup filled with mercury. A second similar cup, placed near the first, is connected with the second terminal; to complete the circuit there is placed over the two cups an iron bridge, dipping at each end into the mercury. These cups are provided with a lid to prevent any spilling of the mercury, this lid being pierced with two holes just large enough to allow the feet of the iron bridge to pass through.

The fine wire of the right hand bobbin terminates at its two extremities at the two terminals of the cut-out; it is consequently in derivation with the thick wire when the bridge is in place; but when the bridge is raised it is alone in the circuit.

As the movable armature never turns through more than 90°, the two ends of the fine wire with which it is wound are connected direct to terminals fixed to the base of the apparatus.

The two large terminals on the left serve to connect the cut-out with the charging circuit; the two smaller ones enable the movable armature to be placed in derivation on a certain number of elements, 10 to 12 for instance, so as to develop in the H-shaped iron a powerful and uniform magnetic field without overheating the wire surrounding it.

The iron bridge connecting the cups electrically is attached to the end of a lever pivoted on a horizontal axle and provided with a movable counterbalance for the purpose of regulation; a rod connects the equipoised lever with a pin fixed eccentrically on a brass disc connected with the axle of the movable armature. The rotatory movement of the latter thus effects, by means of the rod, the raising or lowering of the lever and consequently of the iron bridge.

In consequence of the two arms of the levers with which the rod is connected being of different lengths, the force required to be exerted by the armature to move the balanced lever is extremely slight, a rotation of 90° of the armature corresponding to an angular movement of a few degrees only of the balance lever.

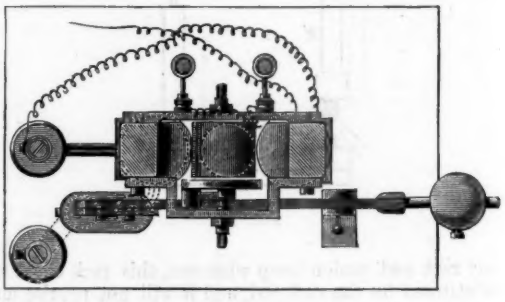


Fig. 2.

The two bobbins of wire covering the inductors are arranged so as to have corresponding magnetising actions on the magnetic surface; the ends of the wire of the movable armature are connected with the poles of the battery in such a manner that the current passes through the bobbins in the direction of the charge, and the armature obeying the laws of magnetic attraction thus tends to keep the lever down, and consequently the charging circuit closed.

Thus, if the current changes its direction in the inductors in consequence of the slackening or stoppage of the dynamo, the polarity of the inductors becomes reversed without that of the armature varying, the latter then being influenced by a double pull, will turn, drawing with it the lever, and consequently breaking the thick wire circuit. When this movement has taken place, the fine wire bobbin alone is in series with the battery and the dynamo; the resistance of this circuit is sufficiently great to prevent the remaining current either weakening or reversing the dynamo if it is a compound wound dynamo; the magnetising action, however, due to the number of turns, is sufficiently great to cause enough magnetism (of the required polarity) to keep the principal circuit open as long as the dynamo does not assume an electromotive force greater than that of the battery.

When, on the conditions of charge becoming normal again, the current passing through the fine wire has resumed its former direction, the same effects as those which caused the disconnection being reproduced in an opposite direction, will effect the lowering of the lever and again close the circuit. It need hardly be remarked that the position of the counterpoise on the lever will cause a variation in the moment at which these two effects are produced; thus, the apparatus might be regulated so that it breaks the circuit for a weak current without the latter even being reversed; the closing of the circuit in this case will be produced much later. In our opinion, the security offered by the new disconnector is such that it could be made to act with safety for a current strength as near as possible to zero, the levers and the armature remaining in equilibrium as long as no current is passing through the various circuits.

As all the movable parts are suspended with the least possible friction, and the apparatus contains neither springs nor a permanent magnet, the cut-out should act always under similar conditions when once the regulation is established. In fact, the experiments made on one of the models

constructed for a strength of 60 ampères enabled it to be seen that the disconnection was produced without hesitation for a current below 1 ampère.

When studying similar apparatus, one thing was noticeable, namely, the difficulty experienced when the current strength exceeds a certain value, in obtaining bobbins capable of withstanding it; moreover, whatever arrangement may be adopted, all instruments of this kind as yet constructed have two grave defects: they can have but very small sensibility on account of the few turns of wire employed, and in the second place they are not adapted to industrial purposes, for they are necessarily expensive and take a long time to construct, having to be specially arranged for each particular case.

I have endeavoured to remedy this inconvenience by constructing our cut-out for a maximum intensity of 60 ampères, which allows of easy winding and the employment of a sufficient number of turns to give the apparatus great sensibility. In order to meet the requirements of cases in which the strength of the charging current is considerable, I have contrived a variable shunt, acting automatically between the terminals of the cut-out, so that the strength of the current passing through never exceeds 60 ampères. This shunt may be formed of two parallel rods of carbon with a diameter suited to the current which has to pass through them, connected electrically at their upper extremities by a metallic plate of more or less resistance. The two rods slide vertically into two tubes filled with mercury, connected respectively with the two terminals of the cut-out; they are suspended to a chain wound on a barrel, on the axle of which is a cog-wheel. A detent engaging in the teeth of the wheel stops the barrel from turning in the direction of the movement which the weight of the two carbons tends to communicate to it; this detent is connected with the movable armature of a small electro-magnet so that the carbons can descend when the magnet, on being traversed by a current, liberates the detent. The weight of the chain is calculated so as to counterbalance as nearly as possible the increasing pressure of the mercury. A pallet, forming part of the movable armature of an electro-vibrator, communicates to the cog-wheel a rotatory movement which draws the carbons up when the electro-vibrator acts.

Thus we see that in order to increase or diminish the resistance of the shunt, all we have to do is to send the current into the vibrator or into the electro-magnet acting upon the detent.

The instrument effecting this operation is a large ampèremeter formed of two circular channels diametrically opposite to one another and connected by a copper bridge pivoted vertically; this apparatus being put in circuit with the wire of the large bobbin and fixed on the iron yoke of the cut-out, the movable copper bridge traversed by the current will tend to form a cross with the yoke forming part of the magnetic circuit.

There being an opposing spiral spring counteracting the electro-magnetic pull, there will be for each strength of current passing through the thick wire a position of equilibrium for the movable part. Two stops, arranged so as to make contact with the bridge in two extreme positions, those due to 55 ampères and 15 ampères for instance, are connected electrically, one at one end of the detent bobbin the other at that of the electro-vibrator; the other extremity of each of these bobbins ends at one of the elements of the adjacent battery of the cut-out. When the strength of the current in the disconnector reaches the higher limit adopted, contact being established by the movable part on the stop connected with the detent, the barrel being set free will unwind until the current strength in the thick wire falls below the higher limit; moreover, this effect will be produced every time contact is made on this side. If, on the other hand, the strength falls almost to the lower limit (15 ampères), contact being made on the stop on this side, the vibrator will work and raise the shunt, and the strength continuing to fall, the carbons will at last leave the mercury and the cut-out will resume its normal position, retaining the same sensibility should the current be reversed. It is clear that this ampèremeter relay may act in the opposite direction; for instance, the carbons may descend when the vibrator works, a counterbalance continually tending to raise them, this solution of the problem is even preferable to the first as regards security.

If R is the resistance of the thick wire wound on the inductor, the resistance of the carbons and mercury together must, at the moment when the carbons enter the mercury, be at least equal to $\frac{R}{2}$; a current would in this case pass in the thick wire from $I = 55$ to $I = \frac{55}{3} = 18$ ampères. As to the resistance of the shunt, when entirely immersed, it is given by $R_s = \frac{R \times 55}{I_s}$, I_s being the maximum strength anticipated. Although the wire can carry, roughly speaking, 60 ampères, the shunts have been calculated for 55 ampères to take into account want of promptness in working.

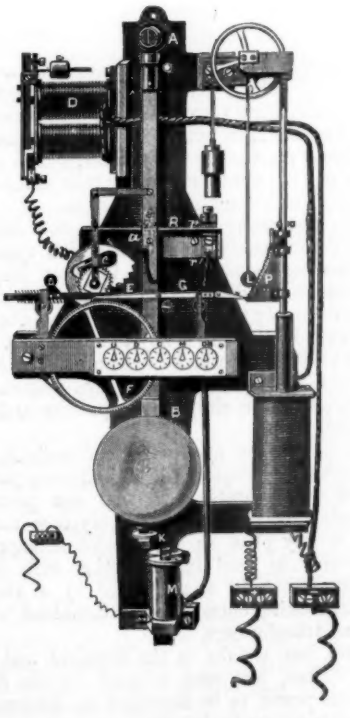
The cut-out is now fully adapted to industrial purposes and one pattern is used for all cases, the only part varying being the shunt.

In conclusion it may be remarked that when once disconnection is effected, although the yoke may be polarised by the discharge current passing through the fine wire, the armature is not traversed by any current; it is consequently inert and the shunt remains without effect and quite out of the mercury. Batteries of accumulators are becoming daily more numerous and more important; it is thought, therefore, that the new apparatus will be a success; the name of the makers, moreover, Messrs. Poilpré & Co., is a sufficient guarantee for its satisfactory working.

A NEW ELECTRICITY METER.

This meter, which presents some features of novelty, is the invention of Dr. Batault, a Parisian established at Geneva; it is represented in the figure.

Essentially, it consists of an ingenious adaptation of Hipps's electric pendulum. The armature, K, at the lower end of the pendulum is periodically attracted by magnet, M, as it is energised by current for a moment sent into it through a make-and-break, A, R, r, r. This pendulum is thus kept swinging constantly at the same frequency.



The pendulum works a ratchet, C, which turns an eccentric, E; this eccentric works a sliding rod back against a spring. The forward play of the rod is restricted by a wedge, P, fixed on the core of a solenoid carrying the consumer's current;

this core is counterbalanced by weights, as shown in the figure, one weight acting with constant force over a pulley, the other acting as a pendulum, L.

The magnet, D, with contact-breaker, H, makes the circuit of magnet, M, on switching in the first lamp, and breaks the circuit on switching off the last lamp, thus starting the pendulum and stopping the pendulum so that no energy is consumed when no lamps are burning.

The action of the meter is obviously simple; when no current passes, or only one lamp is on, the wedge, P, keeps the sliding rod back out of contact from the eccentric, so that it only moves through a very small distance during the short time it is in contact with the eccentric. As more current is passed the wedge moves down through a distance proportional to the increased current, and thus allows of a greater excursion of the sliding rod; the excursions of the sliding rod moves the first large wheel of the index train by a ratchet, as clearly shown in the figure, and thus counts up the distance travelled by the rod—a distance proportional to the current passed.

The pendulum weight, L, is adjusted to cause the core of the main solenoid carrying the wedge to move proportional to the current approximately.

In fig. 2, the connections between the electric supply (+), (−), and the various contacts and coils, can be clearly seen.

The mechanical arrangement of the parts displays considerable skill of a high order; the whole mechanism is carried on one solid rigid foundation plate of metal, forming a good stiff back-bone; the parts once adjusted will remain so, independent of changes of temperature and atmospheric influences and vibrations.

This is a simpler meter than any of the other clockwork forms, and requires no winding up; and it is evident that any ammeter could be substituted for the solenoid and core, provided the wedge moves with the variations in current.

THE NEW SYSTEM OF ALTERNATING CURRENT AND TRANSFORMER DISTRIBUTION.

By RANKIN KENNEDY.

I.

Some seven years ago the author, in these columns, published the first series of articles ever written on "Electrical Distribution by Alternating Currents and Transformers"; since that time, the system then put forth, the single-phase system, has been put into practice in many places, and in the opinion of more than one high authority it has been successful, where properly worked, in accomplishing its aims.

This simple alternating current system does not, however, fulfil all the requirements of a distribution system; but a new system has been evolved which in every respect meets every requirement of a distribution system, and that system has never been simply and clearly laid before the readers of the Electrical Review in a way to arouse that interest in the subject which its importance demands. The author proposes to collect the facts regarding this system into convenient form, and in the simplest way possible to describe the system in detail.

The object of the new system is to distribute electricity over any area for consumption for all and every purpose from one common supply station, so that low pressure, high pressure, continuous, alternating, or polyphase currents, can be supplied at any place in the district of supply, and so that storage may be used in connection with the supply. These objects are fully accomplished by a two-phase or quadrature alternating current supply combined with special generators and transformers.

This system has, thanks to the foresight and energy of Prof. Geo. Forbes, just been adopted for the distribution of the immense power to be developed at Niagara Falls by electricity; a grand beginning for a new system.

The author in March, 1892, contributed a paper on this new system to the Society of Engineers and Shipbuilders of Scotland, in which it is briefly outlined without much detail. This paper is published in separate pamphlet form, and may be referred to; but to begin at the beginning, we will glance over early proposals on this subject, and begin with the dynamo-electric generators to be used for generating the alternating currents in two phases in quadrature.

Many early dynamos were alternators, and some of them generate two-phase alternating currents in quadrature, and it was evidently known by Woolrich when he constructed his historical generator, that two alternating currents in quadrature when rectified and combined into one by two commutators formed a practically continuous current. This Woolrich dynamo, made about 50 years ago, worked successfully for many years and was recently exhibited at Chicago Exposition. If the currents generated by it are taken separately, without the use of commutators, they will be found to be alternating currents in quadrature.

Prof. Holmes, in 1857, devised large dynamos for electric lighting, to run at a speed of 80 per minute, in which two currents, alternating in quadrature, were produced; and other early designers devised machines producing two alternating currents in quadrature. This early production of such machines was very naturally to be expected, for a very simple reason: the early electrical engineers had to deal with the alternating currents as generated by all dynamos, without the knowledge of ring and drum armature and commutator we now have, and in their experiments very soon adopted the plan of using two currents, one of them having its maximum strength at the moment the other was at its minimum strength; it is very obvious that if we commutate two such currents, and combine them, we have a nearly continuous current. This simple expedient was arrived at by early designers before the advent of the Gramme ring and Hefner Alteneck drum armatures.

This leads us now to the simplest of all definitions of the quadrature alternating current. Two-phase currents or quadrature currents, are simply two alternating currents in different phases: "the one current is always at a maximum strength at the moment the other is at a minimum strength." And, any machine which can produce two currents in which the strength of the one reaches its maximum at the moment the strength of the other reaches a minimum, is a two-phase or quadrature generator of alternating currents, or, shortly, is a "quadrature alternator," a name the author suggested some years ago.

Coming to more modern machines, the Gramme auto-exciting alternator, so well known in Europe about 14 or 15 years ago, and which was so largely used for Jablochkoff's candles, is a quadrature alternator. It is necessary to go back to the origin of things electrical when any new departure is made; in practical applications we can by that means arrive at a knowledge of what is new and what is old in the methods and appliances used, and place the credit for invention just where it belongs.

These old quadrature alternators were used for lighting, and with the current rectified, were used for plating and electrotyping, but the properties of the quadrature currents were not then well understood; there were no alternating current transformers or motors to be worked in those days, nevertheless, there they were, ready to deliver quadrature alternating currents if they were (or are) required.

In 1888, quadrature currents were called into use by the invention of an alternating motor requiring quadrature currents to work it. This invention directed the attention of some of the leading electrical engineers in the world to currents alternating in different phases, and many discoveries and developments were made immediately. These were brought forward in a body for the first time at the Frankfort Exhibition in 1891, and created some interest in the subject. The descriptions of the various new machines and appliances shown at Frankfort are scattered over various technical journals, and the little work by E. Hospitalier on polyphase currents, published by the Electrical Review, contains an elementary description of some of it, and forms an excellent beginning for the student of polyphase currents.

Mr. Reckenzaun, and the author, contributed articles on the subject occasionally in the Electrical Review, but the subject was soon allowed to drop.

Mr. Kapp has also referred to the subject in some of his lectures and papers with characteristic skill and insight.

Much work has been done on the continent with quadrature and three-phase systems, but no complete plant designed to obtain all the advantages, and show us the possibilities of

the quadrature system, has yet been laid down. Prof. Forbes is likely to be the pioneer engineer in this system with his scheme for distribution from Niagara Falls.

At Chicago Exhibition the quadrature system was represented only so far as it is used for motive power, quadrature generators and motors being shown in action; and these showed no advance upon those at Frankfort.

Electrical engineers, however, do not seem to have "caught on," as they say on the other side, to the advantages of the polyphase system, and are, apparently, totally blind to its possibilities, just as they were for many years to the transformer. The best of them seem to be quite content to tinker and potter about with single-phase systems, three-wire systems, and five-wire systems.

Having now glanced at the history, origin, literature, progress, and present position of the quadrature system, we can proceed with its description.

It is a universal system on which can be worked anything hitherto invented, or which shall in the future be invented, to work with continuous or alternating currents. It is like the magic bottle from which you can have milk or water, or something stronger, just as you please. You can have it high pressure or low pressure electricity, continuous, alternating or quadrature current; you can use storage batteries freely, and use either alternating transformers or continuous current transformers. As Prof. Bell remarked at Chicago lately, "when you have got an alternating current you can do something with it." And the author adds, "and when you have got two alternating currents in quadrature you can do ten times more with them."

THE RETURN CIRCUIT FOR ELECTRIC RAILWAYS.

An important report was presented by Mr. McTighe to the recent meeting of the New York Street Railway Association, upon the return circuit for electric railways. The author, in attempting to collect data upon this subject, experienced the same difficulty that we encountered when we endeavoured to collate American opinion upon the earth return. With all their accumulated experience American engineers still differ as to the best method to adopt. Some of Mr. McTighe's conclusions are worth quoting. The earth return, pure and simple, the author considers, is not to be relied on. He believes that the track rails could be used largely for a return circuit, and that in most cases a supplementary wire was an unnecessary expense, and would be soon discarded altogether. To many railroad engineers this is rank heresy, but it must be admitted that there is some reason in the following argument:—

"In steel rails it is usually said that every ten pounds weight per yard means one square inch of cross-sectional area. And every square inch of such area can be brought to terms of copper by dividing by six. For example, take the average city railway rail as being a 70-pound girder. Its area is substantially seven square inches, and the four rails of a double track make 28 square inches, equal to a single steel bar four inches thick by seven inches wide. This is electrically equal to a bar of copper having 4·66 square inches area, or, in other words, a copper conductor one inch thick and almost five inches wide. With such a magnificent path for the returning current, does it not seem absurd to supplement it with a No. 0 wire, whose area is that of a rod a little over a quarter of an inch square? The above rail resistance per mile to be but ·0086 ohm, while that of the No. 0 wire is just 60 times greater."

As an instance of the extreme inconvenience arising from the use of supplementary wires, Mr. McTighe quotes the case of the West End and Brooklyn City Railroad Companies, where double supplementary copper wires were laid, but they were found utterly inadequate and the engineers had to put up many miles of huge return feeders at great cost. In Brooklyn these return mains are, when possible, suspended on the elevated railroad structure; occasionally, however, the insulation scrapes off and the return main makes contact with the ironwork. Heat is developed at this leak which is sufficient to soften the insulation for many feet, thus showing that the resistance of the main return is still too high.

There is a touch of real unconscious humour in the author's remarks on electrolytic decomposition resulting from an earth return of the earthiest kind.

"As an extreme case, it would scarcely be an exaggeration to assume that in Tremont Street, Boston, or Fulton Street, Brooklyn, there is a massing of slowly moving cars, amounting to, say, 100 for one mile of double track. Let the rails used be 70-pound girder, and for the current, say, about 20 ampères per car for 15 hours per day would be a fair average. $100 \times 20 \times 15 \times 365 = 10{,}950{,}000$ ampère hours per year. If all this went back to the generator by way of the earth, the decomposition of the rails every year would be 7,665,000 grammes, or about 17,000 pounds of iron—nearly 8 tons lost from the mile of double track in one year. This cannot be entirely avoided, but can be reduced to a minimum by giving the track circuit as great an electrical value as possible, and might be retarded by dipping the rails before laying similarly to gas and water mains."

Rail bonds, to which English readers are more or less impervious, form a large part of the author's treatise. It appears that the form which meets with Mr. McTighe's approbation is a bond of the heaviest practicable size, combined with the shortest possible length.

ON THE CHLORIDE ELECTRICAL STORAGE BATTERY.

The paper contributed by Mr. Herbert Lloyd, F.C.S., to the *Journal* of the Franklin Institute, fails to prove that this battery is superior, or even equal, to batteries which have been in use in England for several years, nor does the process of its manufacture compare favourably as regards simplicity and quickness of formation with several other well-known batteries. Besides, there are some contradictions in the paper such as, for instance, the assertion that "the plates are suitable for immediate use in a storage battery without the tedious forming process of Planté," compared with the avowal that "after the plates are removed from the hydrogen bath they are charged continuously for several weeks." The complication of the different processes necessary to arrive at the formed plate will best be seen from the following enumeration, which is compiled on the basis of Mr. Lloyd's paper:—

1. Sub-dividing the lead by delivery in its molten state into a jet of dry steam.
2. Dissolving the finely divided lead in dilute nitric acid to form nitrate of lead.
3. Adding hydrochloric acid to the solution of nitrate of lead to precipitate chloride of lead.
4. After mixing the chloride of lead with chloride of zinc, casting of tablets.
5. Uniting a number of these tablets to a plate by casting a lead frame round them.
6. Reducing the tablets to metallic lead by placing them in a solution of chloride of zinc and using zinc plates as anodes (time, 12 to 24 hours).
7. Washing the plates in running water to remove all traces of chlorine.
8. Setting up the plates as cathodes in dilute sulphuric acid, using plain lead plates as anodes and passing a heavy current for several hours to ensure the complete removal of chlorine from the plates.
9. Forming the plates as positive electrodes, with plain lead plates as negatives, continuously for several weeks.
10. Charging and discharging the cells several times until they give their proper capacity.

It appears that greater uniformity in the porosity of the plugs can be obtained by this process than where red lead or other paste is used, and the capacity of the plate will certainly be proportional, within certain limits, to such porosity; but it must be borne in mind that the limit is soon reached where the greater porosity can only be attained at the cost of mechanical strength. As a matter of fact, plates made by this process, which have been in use for some time as positives, very much resemble in appearance plates which have been pasted in the first instance.

The capacity of between 5 and 6 ampère hours per lb. of plate is not higher than that of other good types of accumulators, and the rate at which this capacity is obtained, viz., half an ampère for 1 lb. of plate, is low.

As regards the efficiency, which is given as 90 per cent. in quantity and from 75 to 85 per cent. in energy, something more definite will have to be known before any information is available, as it is quite clear that with a loss in quantity of 10 per cent. the loss in energy must be considerably more than 15 per cent. Again, the further test referred to where the cell had been allowed to stand for 24 hours does not allow any valid conclusions to be drawn as to how such a cell would behave after long rests either in its charged or discharged state. We know of one type of cell where the loss in quantity efficiency, after a rest extending over three months, only amounted to 20 per cent. It would be interesting to learn what the corresponding figure in a chlorine cell is?

As regards the letter from Messrs. Furness, Evans & Co., the architects who had the awarding of the contract, of which the author says that it speaks for itself, we must be excused if we fail to see that a delivery of 1894 ampère hours by a battery of about 2,000 ampère hours capacity is equivalent to an excess of 48 per cent.; or should it be inferred that the "guaranteed" capacity fell so far short of the 2,000 ampère hours that this accounts for the excess?

The use of asbestos cloth, however beautifully woven, to guard against the falling off of active material had been adopted by several makers many years ago, but has, in most instances, been discarded again.

We are of opinion that the object to be aimed at is to obtain active material of such consistency that no mechanical means for securing it in place are necessary, and accumulators on an improved Planté type come very near to realising this object.

REVIEW.

Electric Light and Power Distribution. Part III. (final). By W. Perren Maycock, M.I.E.E. Whittaker & Co., Paternoster Square, London.

This part deals with accumulators or storage batteries, a subject fairly well treated so far as it goes, but the setting up and care of storage batteries ought to have been referred to; the strength of the acid solution, the testing of same by hydrometer, the failure of plates, and other subjects with which the elementary student ought to be acquainted are passed over without a word. This book then deals with transformers very briefly. The choice of an illustration showing what is a core transformer is somewhat unfortunate; it shows *a core transformer*, no doubt, but it also shows how the coils on a transformer should *not be put on*, a fact which might have been profitably dealt with, otherwise this chapter on transformers will be useful. Then electrical distribution is briefly dealt with, the author expressing some curious opinions on the merits and demerits of the various systems. It is stated that the "choice of the method of distribution is governed principally by the district which is to be supplied"; well, it ought to be, but, as a matter of fact, it is mostly governed by the bias of the consulting engineer for the district. The author falls into the use of the played out arguments against the use of alternating currents for distribution, namely, that it cannot be used for motive power, electroplating or typing, the fact is that motive power is very sparingly used on any system in Great Britain, and can, if wanted, be supplied on either system, while as for electroplating and typing, we doubt if the continuous current systems reap any profits from or even supply current to any electroplaters or typers, most of them, for good reasons, generate their own current. And it is possible to supply even an electroplater or typer with current from an alternating supply; and, as for secondary batteries on alternating current systems, it should not be positively stated that "they cannot be used with alternating currents." There are several practicable methods of using them whenever the necessity arises. Passing from the opinionative part of this chapter the rest of it is useful reading, well written.

Chapter XVI., "Electrical Measurements and Calculations," is the best in the work for the purpose of the student.

The last chapter very briefly refers to "Possibilities of the Future," a subject which does not lend itself readily for brief treatment; it is too vast. It also refers to electric railways, concentric wiring, Tesla's experiments, Swinburne's condensers, in a few words only. A paragraph on alternate current electro-magnets corrects a statement previously made "that alternate currents could not excite an electro-magnet." But another error is made by stating that "this is true when the magnet has a solid core." Now it is not true in any case; the solid core would heat up, but it would be excited all the same. The core is laminated to prevent heating, not to obtain magnetic excitement.

Taken as a whole, the three volumes, of which this is the last, are, with the few exceptions pointed out, somewhat above the usual text-book level, and, no doubt, in another edition, will be much improved.

CORRESPONDENCE.

Megohms: Limited or Unlimited?

Your leading article last week, on "Competition in Electric Light Leads," tempts me to open up two or three questions in connection therewith that are, perhaps, worth ventilating.

What a change—or, rather, what a series of changes—have come over the trade within the last 13 years! At that time a covering of cotton or hemp, more or less saturated with tar, pitch, or some mysterious and "patent" compound, according to the fancy of the manufacturer or the user, was considered all-sufficient for electric light purposes. Whoever heard of megohms in those days? If better insulation was asked for, the coatings of hemp and compound were multiplied accordingly.

The next move was made by the addition of one or two spiral coverings of pure India-rubber; anything beyond this was considered the height of extravagance, and an expense that no installation could reasonably be expected to stand.

As dearly-bought experience showed the necessity for better insulation in certain cases, alleged waterproof tapes and compounds were introduced, the illusion of whose waterproof qualities was quickly dispelled when they came to be used under water for any length of time.

We then saw the introduction of a very low class of rubber compounds, giving a tubular covering when new, but very soon degenerating and cracking when exposed for a few months to the atmosphere. It must have been this class of cable that a certain leading light in the electrical world had in view when he gravely suggested allowing for the effects of these cracks as a matter of course when adjusting the thickness of the dielectric necessary to prevent sparking, a suggestion that must have been intensely amusing to the knowing manufacturers.

About this time, also, we were inundated with various types of lead-covered cables, emanating chiefly from America, whose insulation was said to depend upon some profound secret locked up in the breast of the inventor, but whose life, nevertheless, depended actually upon the lead tubing remaining intact.

By gradual evolution, we have finally had to return to what the older manufacturers must for a long time seen inevitable, viz., a close approximation to the cables used by the old submarine telegraph world.

But here, I should like to ask, are we not in danger of carrying things to unnecessary extremes? I am convinced that a deal of money has already been spent in higher insulation than was really necessary.

A certain class of electrical engineers, having once tasted the sweets of abundant megohms, are constantly crying out for more. Do they really know what they are asking for? What will they do when they get them? There seems to be a widespread impression that a cable of 2,000 megohms insulation per mile, if not actually worth ten times, is at least under any circumstances worth a great deal more than one of 200 megohms per mile. It is hard to convince some people in the face of this idea, that a cable, covered for

instance with gutta-percha of, say, 300 megohms insulation per mile, is for some purposes infinitely preferable, and worth more in actual money value than a cable covered with other materials to 2,000 megohms or more per mile.

Do many users of electric light cables appreciate that in at least seven cases out of ten for all low tension purposes, other things being equal, an insulation of one megohm per mile is quite sufficient, and as far as the efficiency of their installation is concerned, to demand anything beyond for the sake of insulation alone is asking and paying for something they really do not want, and the money might be far better spent in perfecting other details of the installation, among other things the proper making and insulation of the joints.

If a material could be introduced of low specific insulation, giving, say, with a reasonable thickness of covering an insulation of only one megohm per mile, and that would not be decomposed by the action of the electric current, and at the same time answer the other purely mechanical and commercial conditions that are necessary, viz. : that it should be cheap, easy of application, thoroughly waterproof, capable of rough handling, and not influenced by the usual climatic changes, I am convinced it would answer in the majority of cases equally as well as the cables now in vogue. Moreover, it may seem rank heresy on my part to say so, but I venture to predict that before many years elapse electrical cables for certain purposes will be advertised somewhat as follows :—

"We beg to announce that by our patent system of covering we have reduced the insulation to x thousand ohms per mile, without in any way impairing the durability, which we guarantee, &c., &c."

Also that other electrical properties will come more to the front, and x megohms insulation per mile will have to take a back seat altogether.

What reason is there, therefore, for the demand and the commercial value that is at the present moment given to high insulation ? So far as I can see, it is almost entirely a manufacturers' question ; most cables are being covered with compounds based upon India-rubber, and India-rubber has a specific insulation enormously high compared to the actual needs of electric light cables, the other ingredients introduced, generally, though not necessarily, lower the insulation ; but with India-rubber as a basis and with a perfect covering the insulation could never be reduced to anything like as low as one megohm per mile.

These ingredients in rubber compounds may be used :—

1. As a necessary part of the process.
2. To cheapen the product.
3. To increase the durability or to meet with special mechanical conditions.

Do the three qualities, high percentage of India-rubber, high insulation, and durability, necessarily go together ?

If the coverings are intelligently carried out by experienced manufacturers, I agree that, to some extent, they do, but not entirely so, especially as regards durability.

I believe that if the manufacturer had more scope in this direction, and was not judged purely from a megohm point of view, he would probably produce a more durable cable without any extra expense.

What I wish to point out is, that users should not give an exaggerated importance to the high number of megohms insulation per mile, which is a mere accident due to the material employed, and is, *per se*, of little commercial value to them ; to look rather to those other qualities that I have pointed out, and especially durability, and given the conditions under which the cables have to be used to insist upon a long guarantee of their life from the manufacturer.

Regarding the special price list you refer to, I do not think there is any material alteration in either the thickness or the composition of the various insulations ; they are simply taking the public more into their confidence, and making known to them what they must have known themselves for some time.

If the insulations of the various conductors in any one type are compared by the proportion of log. $\frac{D}{d}$, it will be seen that the insulation agrees fairly well with what it should theoretically be, but I must admit it speaks well for their confidence in the perfection of their own manufactures for them to guarantee this close approximation to theory.

I thoroughly endorse what you say regarding the folly of starting a cut-throat competition between manufacturers. I see no valid reason for such a policy at the present moment ; and although the consumer might gain a temporary advantage, it would be a matter of loss and regret to all concerned in the long run.

James Connolly.

October 23rd.

What is Lithanode?

Mr. Desmond Fitz-Gerald appears anxious that I should send a few words of explanation to your Journal. The words referred to in this gentleman's communication, in your issue of last week, have appeared in several editions of my book, and, until now, no question has arisen in regard to them.

Personally, for the want of evidence to the contrary, I have regarded the lithanode plate as Mr. Fitz-Gerald's production, and considered this to be a peroxide plate produced by a special process, so that probably there are other chemical substances in combination with the lead salt, but notwithstanding which, it might fairly be called a peroxide plate.

A great many have taken objection to the word lithanode, and a fair interpretation of my words would be the following :—

"That although the solid peroxide plate was known, Mr. Fitz-Gerald is probably the first gentleman who has made such a plate in a practical form by his process, but that it would have been better to have called the plate 'Fitz-Gerald's peroxide plate,' or 'positive plate.'"

David Salomons.

Electrical Education.

Mr. Perren Maycock's article on "Electrical Education" is very much to the point on the qualification of the ordinary working electrician.

The classes open to the artisan or apprentice engineer require to work up to a syllabus which attempts far too much, consequently there are very few of the young men of that class take advantage of them ; the consequence is that we have a class of men who actually do the work in our shops, and on contracts, who know little or nothing of the science of their calling.

On the other hand, a great number of young men, with means and time at their disposal, qualify at the technical schools ; but these cannot be drawn upon for the actual workers' duties ; a few of them do take up practical handiwork, and later on rise to important positions, but the majority fall into office work or commercial work in connection with electricity.

The proposal to form a lower class, and issue a certificate within the reach of workers, is one which has much to recommend it ; but it should treat and refer to more than electric bells. An elementary electrical engineering evening class should be opened in all the institutes in districts within easy reach of the artisan class, and certificates offered to those who pass.

Rankin Kennedy.

I notice in last week's Electrical Review a very good article by W. P. Maycock, and there are two or three points which, I think, the Examination Department of City and Guilds ought to have their attention called to.

In regard to the preliminary examination in electric lighting, I think they are making a mistake in not awarding certificates to those who successfully pass the examination, as there is nothing which makes a new student feel so proud and gives him so much encouragement, as when he possesses a certificate for having successfully passed an examination ; then again, if a student does successfully pass an examination and he does not receive a certificate for same, he naturally thinks that if the examination is not worth the giving of a certificate, that the examination is not worth going in for. In regard to the Ordinary Grade Examination in electric lighting and power transmission, I think it is one of (if not) the hardest ordinary examination under the City and Guilds' programme ; the questions are much too hard

for what an Ordinary Grade student should be expected to know; there *is not* the difference of standard between the Ordinary and Honours Grade Examination that there should be: the Ordinary Grade Examination at present is very nearly as stiff an examination as the Honours, and I am sure it would be more encouraging, both to teachers and students (and also cause an increase of electric lighting students), if the Ordinary Grade Examination was made easier. For instance, what could be more absurd than setting a question like No. 5 of last year's Ordinary Examination in electric lighting, &c., thus:

A four-pole motor armature, 24 inches diameter, series-wound, with 202 external conductors, takes 300 ampères at 210 volts. Flux of lines from one pole, 9,000,000 C.G.S. measure (or 1,500 lines English measure). Assume field magnets to be separately excited, and armature to work with 95 per cent. efficiency. Find (*a*) speed; (*b*) horse-power; (*c*) tangential pull of armature conductors.

A student, to work such questions as these, requires to have a good knowledge of mathematics, which nine out of every ten students have not.

Wm. R. Bowker.

Jerry Wiring.

With regard to Mr. Haynes's letter of last week, I would like to add that there is urgent need for some supervising body in addition to the usual insurance inspectors, as it is an undisputed fact that installations are being carried out and passed which are directly opposed to all insurance principles. I myself know of one installation in the City of London where the branch wires are passing as much as 3,000 ampères per square inch. I took the trouble to mention this fact to the contractor, and was told, "Well, the insurance companies have passed it."

This sort of business cannot go on for ever, so that the sooner something is done to prevent it, the easier our future will be.

Wallace J. Lambert.
Per J. W.

Water Power.

In last week's Electrical Review, in your remarks on the Transmission of Mechanical Work, you say we have no Alps or Appenines to pour perennial streams, hence, pending some capital invention for utilising tidal power, &c. I may here say that after a great many years of thought and experimenting, and a large outlay, I have succeeded in doing the following with tidal power—that is, I can work from the tides every hour of the twenty-four throughout the year. In addition to this, I can start the turbines at any height of the tide, and even at low tide. There is no deception about this, as I am a practical engineer, and believe in the old saying that a pound of practice is worth a ton of theory. I have had a large experience in water power as well as steam. I may say that the first outlay for my plan would be about the same as for steam engines, power for power, whilst the saving ever after I calculate at eighty per cent.

Edward Davies.

Electrolysis: An Enquiry.

I should feel obliged to any of your readers who can inform me if there be any special literature, and where I can find it, dealing with the subject of electrolytic separation and convection, particularly any papers dealing with these phenomena, and showing the connection between them and the specific capacities of the elements for receiving electric charges.

R. C. J.

Information Wanted re Pumping by Electricity.

We have a well about 23 feet deep, with an inexhaustible supply of water. We wish to raise that water to a reservoir 500 yards distant, at an elevation of about 80 feet from the well. Could an electric motor be made to work a pump (or anything of a similar nature), if the power were supplied by an electric cable from an engine 500 yards distant, or from a water-wheel two miles distant? The quantity to be raised daily would be 50,000 gallons. What power would be required?

J. G.

[No doubt several of our advertisers would be glad to undertake this business, and give our correspondent the information he requires.—Eds. Elec. Rev.]

Lightning Express Railway Service.

Mr. Radcliffe Ward, telegraphing from Liverpool too late for our last issue, states in regard to Mr. Behr's lightning express railway service:—"Chicago-St. Louis track for 100 miles an hour trains, ordinary permanent way proposed; Behr's more feasible; strongly opinion there is demand fast traffic, and that such will be proved when two towns are linked with ordinary railway and Behr's in competition. Behr's will take bulk traffic. Increased speed is, to my mind, certainly natural. Development age impossible restrain."

Re Incandescent Lamps.

A gentleman, hiding himself behind the letter "G," makes some comments on my letter addressed to you upon the incandescent lamp question. Only his reference to Mr. Edison, endeavouring to set me right in my statement that Mr. Edison had nothing to do with the English company, and had not heard from them for some time, requires a short answer from me. The rest of the letter is obviously too partisan to need any reply.

"G" may rest assured that the statement I made upon Mr. Hirst's authority is correct. "G," who appears to know the ins and outs of the Edison-Swan Company's affairs, will no doubt remember that the dividend he refers to had not been declared in April last, the date of Mr. Hirst's interview with Mr. Edison. Since April a small dividend has been paid upon the "B" shares, but I do not think that the fact of this small payment has altered Mr. Edison's position in the matter referred to in my letter. I understand this is the first time a dividend has been paid since the shares were issued, about 10 years ago. Let us hope many more will follow.

G. Binswanger.

NOTES.

Yeadon Electric Lighting.—The Local Board are applying for a provisional order. It has also been decided to make application for sanction to borrow £7,000 for such a purpose. The compulsory area for lighting has been decided upon, the extreme ends of the township being left out.

Electrical Spectacles.—A few weeks ago we recorded the latest branch in electrical quackery, and we now learn that the Irishman referred to, who induced a lady to pay him £4 for a common pair of spectacles, under the pretence that they were electrically charged, has been sentenced to two months imprisonment, with hard labour, for the offence. His son was discharged.

Electric Lighting of Trains.—A French contemporary is publishing a continuing article on this subject, in which they deal with some recent experiments carried out in Germany, with batteries of Khotinsky accumulators of a discharging capacity of 112·5 ampère-hours, with an electromotive force of 16 volts and a load of 277 kilogrammes. Each carriage contained three batteries, two for immediate work, and the third for facilitating and rendering more rapid the charging operations. The two batteries lighted eight 4-C.P. lamps and four 2-C.P. lamps, discharging at a tension of 16 volts. These lamps were on two separate circuits, lighted by two batteries. The cost of the installation per lamp amounts in round numbers to 200 francs.

Queenstown and Electric Lighting. — There are rumours that a movement is on foot for providing the town with electric light.

A Piezo Electric Pile.—Lord Kelvin the other day read a paper before the French Academy of Science, the subject being "A Piezo Electric Pile."

Electrocution.—Reports from America state that the latest attempt at electrocution has been successfully carried out. Morton Foy was the victim, and he was executed in Dannemora prison for murder.

The Mechanical Equivalent of Heat.—Referring to the experiments of Mr. E. H. Griffiths, M.A., upon "A New Determination of the Mechanical Equivalent of Heat," which were recently described in our columns by Mr. Rollo Appleyard, the *Electrical World*, N.Y., "Digest" complains that the experimenters have not stated their deductions very clearly. The *Proceedings* of the Royal Society, and our article, tabulates them thus :—

J = 427·45 kilogrammetres in latitude of Greenwich (g = 981·17).

J = 1,402·2 foot-pounds per thermal unit, C., in latitude of Greenwich.

J = 778·99 foot-pounds per thermal unit, F., in latitude of Greenwich.

But the "Digest" is good enough to suggest that "the following is evidently that which was meant :—1 klgr. C.° unit of heat = 427·45 klg. metres in the latitude of Greenwich (g = 981·17); 1 lb. C.° unit = 1,402·2 foot-pounds, and 1 lb. Fahr.° unit = 778·99 foot-pounds, both in the latitude of Greenwich." The results recorded in the *Proceedings* Royal Society are generally very fairly accurate, and we are surprised that they should have omitted this important cross-statement of the deductions. For ourselves there is of course no excuse, we submit entirely; but, at the same time, we have not yet perceived the great advantage to be gained from American versions of English fact; and as to clearness ——. Well!

The New Pacific Cable.—A telegram dated Montreal, October 19th, states that "Mr. Hosmer, general manager of the Canadian Pacific Telegraph Company, contends that the Canadian Pacific telegraph with its Atlantic cable connections can be made to form the cheapest and quickest route for telegraphic communication between Great Britain and Australia, and expresses the belief that the growing commerce of the Pacific Ocean demands that this cable should be laid. He says that the Canadian Government and most of the Colonial Governments interested have for some years been willing to contribute a share of the subsidies required, but the main difficulty has been to interest the Imperial Government. The latter have, however, had the matter brought prominently before them by the fact that the French Government has granted a very liberal subsidy to the company laying the cable between Queensland and New Caledonia, which section the company claims will form an important link in the main cable to Vancouver, British Columbia."

A telegram from Brisbane on 25th inst. reads as follows :—"Sir Thomas McIlwraith, the retiring Premier of Queensland, replying to the regret expressed by the Marquis of Ripon, the Secretary of State for the Colonies, at the action of Queensland and New South Wales in committing themselves to the laying of a cable to New Caledonia, which its promoters claim will serve as the first section of a trans-Pacific cable connecting Australia and Canada, remarks that the complacent policy of Great Britain has allowed foreign Powers to acquire territory in the Pacific to the injury of the future of Australia, and he especially instances the establishment of a French convict settlement in New Caledonia. Sir Thomas goes on to contend that the construction of the cable between Queensland and New Caledonia will mitigate evils which already exist, and declares that if the protest of Australian statesmen had been promptly heeded in the past, much inconvenience and injury would have been prevented. Queensland, he said, always favoured the construction of a purely British cable across the Pacific, and would warmly welcome the support of the mother country to such a scheme."

Personal.—We are informed that Mr. Marillier has resigned the editorship of *Lightning*, and will henceforward devote himself to general journalism. We have every reason to believe that he will be a pronounced success in his new avocation; anyhow, he has our most cordial wishes for his success.

Berlin Electric Lighting.—A contemporary states that there are at present in Berlin connected with the supply system of the Berlin Electricity Works, about 160,000 16-C.P. incandescent lamps.

Portsmouth Electric Lighting.—The contractors are making rapid progress with the electric lighting work. The inauguration of the works will devolve upon the new Lord Mayor, who, it is said, is desirous of making a great day of the opening ceremony.

Result of French Litigation.—A few weeks ago we gave an account of the case of Messrs. Zipernowski, Déri and Blathy *v.* The Compagnie Internationale d'Electricité de Tours, in which judgment was given for the plaintiffs. The latest development of the matter is that the plaintiffs have seized the transformers of the Thomson-Houston and Ferranti type used at Havre by the Société l'Energie Electrique. There is probability of further litigation ensuing as a result of this seizure.

Cable Rates to the Cape.—Sir John Pender, as representing the telegraph system to Cape Colony, is exhorted in the columns of the *South African Export Gazette* to exercise his influence towards effecting a reduction in the telegraph tariffs between England and the Cape. Efforts recently made to lower the excessive charge of 8s. 11d. per word have, up to the present, met with little success. Chambers of Commerce, merchants, and others interested in South African business have considered the question, and the detrimental effect of exorbitant and prohibitive tariffs on the development of commerce in South Africa. A lower tariff would almost certainly bring with it an increased traffic, and might thus in the end be advantageous to the Eastern Telegraph Company as well as to the commercial bodies, especially now that a certain Mr. Walker suggests "a competing line" as the best means of redress.

A New Danger from Lightning.—Writing to *Industries* Mr. A. A. Voysey gives an account of an apparently unusual cause of damage by lightning. In a room in a country house near Nottingham stood a table "ornamented by a fringe fastened securely to it by nails. This fringe had been almost entirely burnt on the side of the table facing the room, and the burning had partially extended to one other side. The wood was charred to a depth of $\frac{1}{8}$ to $\frac{1}{4}$ of an inch where the fringe was burnt. If the table had been struck by lightning there must have been some marks in the room showing where the discharge had entered and where it passed to the earth. But not a mark or sign of any kind could be found, and the damage to the table was completely isolated. A rigid inquiry proved that no one had entered the room with a candle. The only possible explanation of the occurrence was suggested by an examination of the fringe. It was found to consist of a fluffy material, probably a mixture of cotton and wool, and certainly of an inflammable nature. Interspersed among the fluffy material were fine metallic threads. Now it is in this combination of inflammable material with the metal threads that the explanation lies. The metal threads were acted on inductively by the lightning discharges taking place near the house. This inductive action was sufficient to cause small sparks to fly between various threads, and the sparks set the inflammable material on fire. If the fire caused in this peculiar manner had not quickly died out, the whole house might have been destroyed, and no sign would have been left to point to the true cause. It is not unusual for fires to occur in connection with thunderstorms, and they are generally attributed to the direct action of a lightning discharge. Possibly a large percentage of such fires have been caused by induction, and the simple incident which has come to my notice is sufficient to show how easily the inductive action may cause a fire."

A Cadmium and Ammonium Chloride Battery.—Whilst engaged in the study of the Leclanchè battery a short time ago, Mons. A. Ditte examined the behaviour of a cadmium-platinum couple in sodium chloride solution, and has since made this couple in ammonium chloride the subject of a paper contributed to the proceedings of the Paris Academy of Science (*vide Comptes Rendus*, cxvi., pp. 1,128—1,131). He finds that the electrolysis of a solution of ammonium chloride by a cadmium-platinum couple is exothermic, even when the heat of formation of the double ammonium-cadmium chloride is not taken into account. The ammonia tends to accumulate in the upper part of the liquid and the cadmium chloride in the lower part, but since cadmium oxide forms rapidly in the presence of ammonia, the liquid near the surface becomes saturated with crystals of a compound of ammonium chloride and cadmium oxide. This change is accelerated by the substitution of a compressed mass of manganese peroxide, or a porous pot containing peroxide, for the platinum. A diaphragm of the same compound shortly forms and separates the liquid into two parts of different composition; here the electrical resistance is smaller than at any other part of the liquid, and the cadmium is more rapidly attacked. Mons. Ditte cannot discover that the manganese peroxide plays any other part in this cell or cells of analogous structure, than that of rapid depolarisation.

The Hôtel des Téléphones, Paris.—In a few days the inauguration of the new Hôtel des Téléphones (Exchange), which has been established in Paris beside the Hotel des Postes, will take place. The new building consists of a ground floor and two very light upper stories with large bay windows. The ground floor will be used for the international and metropolitan lines, and will comprise a laboratory for trying the lines and public offices for Paris, the provinces, and foreign service. On the first floor, also, there will be public rooms for metropolitan and international communications. The second floor is set apart entirely for the service of Paris and the suburbs. From this department will be worked the official lines of the State and the public line; the international lines, and the lines belonging to a certain number of subscribers now connected with certain offices about to be closed, such as the offices of the Avenue de l'Opéra and of the Rue Etienne-Marcel. The Hôtel des Téléphones can meet the requirements of 6,000 subscribers. Formerly there were 12 central telephone bureaux in Paris, but this number greatly interfered with the rapidity of the communications. It was therefore decided to suppress all these smaller bureaux and replace them by four larger ones, using more power. The first of these, which is the Hôtel des Tèléphones, and the second, which is situated in the Avenue Wagram, are already in existence, and two others are about to be established.

How Electricity is Encouraged.—The Bishop of Urgel, in the Republic of Audorra, a few weeks ago prohibited and anathematised the installation of telephonic apparatus and other supernatural and diabolical electrical sortileges. This interdiction of telephones, phonographs, &c., reminds one of the taboo which the Ediles of the Ville Soleil, Paris, inflicted on electricity and the electric light in 1853. Some induction coils were then installed in some wine and spirit shops, where shocks were administered to customers in a manner similar to the present automatic machines. The Municipal Council forbade the use of such electric machines, as being a *source of accidents*. A year later, an enquiry was held on the treatment by electricity, which an electrician of the Conservatoire des Arts et Mètiers was applying to cure some diseases. The Municipal Council of Paris decreed that the *treatment by electricity was dangerous*, and suppressed it. This enlightened municipal council had, however, in 1851, authorised Archereau (who died this year in deepest misery) to use a battery of 60 cells on the Boulevards at the corner of the Rue Rougemont, for his electric lamp and electroplating experiments. The whereas of the decree was, that there was *no risk of explosion or of fire in using such a battery*. The same intelligent body had also authorised the owner of a café to have an electric lamp on his premises, but on the express condition that the rays from the lamp *should not fall outside*, because *they might frighten the horses* passing the café.

Hanley Electric Lighting Extensions.—Extensions of mains, &c., at a cost of £1,300, are to be carried out.

The Meidinger Cell.—In the original form of Meidinger's "two-fluid" cell crystals of copper sulphate lie in an inverted flask filled with zinc-sulphate solution; and the heavy solution in this flask sinks down whenever the density of the lowest layer (the solution of copper sulphate) diminishes, in consequence of the deposition of its copper upon the positive plate. Simple modifications of this original form are much used on the Continent and elsewhere in telegraphic practice. A. A. Krakau recently undertook an investigation of all known cells of the Meidinger type, with a view to ascertaining which form is most suitable for this kind of work. He found great variations in the E.M.F., efficiency, &c., of precisely similar elements, and hence was unable to arrive at any definite general conclusion. He is of opinion, however, on reviewing the results obtained, that several obscure secondary reactions play a more important part in the action of these elements than has hitherto been suspected. Evidently, the subject calls for further investigation.

The Temperature Variation in the Electrical Resistance of Copper.—In a paper by Messrs. A. E. Kennelly and R. A. Fessenden, recently read before the Electrical Congress, Chicago, it was stated that the results of measurements showed that the relation between the resistance and temperature of the wire between the limits of 20° C. and 250° C. indicated a uniform temperature coefficient of 0·406 per cent. per degree Cent. throughout that range, the maximum observed being 0·4097 per cent., and the minimum 0·399 per cent. at any point. In the discussion, Mr. Preece pointed out that at Cambridge the various discrepancies as to the specific resistance of copper are attributed to a difference in density. Matthiessen, he said, used copper of a density of 8·9, while that of the Cambridge experiments was 8·946, and the difference in specific resistance was found to form a direct ratio between these numbers. He complimented Mr. Kennelly highly on his work, and said that the result of his paper would be to compel English electricians to accept his coefficient without the slightest hesitation.

Electrolytic Separations: A Suggestion.—Attention is very opportunely called by F. Oettel to the want of precision commonly adopted in describing the conditions under which electrolytic processes should be carried out. It is the custom to state that with a current of so many ampères the metal undergoing electrolytic extraction separates out in a state of purity and in a compact form. This, however, is quite insufficient to enable another person to repeat the operation with a certainty of success, as the most important factor in the separation of a metal in a given condition is not the strength of current, but the current density; that is to say, the number of ampères per unit of area of the electrode. All who record the results of investigations of this kind should select the square decimetre as the unit of area, and state that the separation is effected by a current of so many ampères per square decimetre of cathode. It is important to note that the current density will not be uniform over the surface of the cathode if the latter be in the shape of a cylinder, for example, surrounding a rod which serves as the anode. In this case the density will be greater on the inner surface, and more metal will therefore be deposited there. It suffices in such cases to state the average current strength referred to the whole immersed surface of the cathode, and to mention the shape and disposition of the cathode, the object being not in this case, perhaps, the attainment of rigid accuracy in stating the current density, but the indication of it in such a manner as will enable another operator to reproduce the conditions which experience has shown to be successful. It is desirable, moreover, to state the voltage of the current, although this is of less importance than the current density. This especially cannot be neglected in such a case as has recently been demonstrated where the electrolytic separation of metals, the heat of combination of whose salts differs appreciably, can be conveniently effected by the use of a current of regulated pressure, which may be arranged so that the metal whose heat of combination is lowest may be extracted by itself, first leaving the others in solution.

Castleford and Electric Lighting.—An offer made by Mr. Robert Hammond of the terms on which he would advise the Board as to the best means of lighting by electricity, preparing plans, and doing all the necessary work up to the time of making application to the Board of Trade, has been accepted.

Magnetite Rocks.—Attention has been repeatedly called by American geologists to the existence of certain schists associated with the ores in the older iron regions of the Lake Superior district. These schists are largely composed of magnetite, which occurs in proportion 50 to 90 per cent. of the entire rock mass; they are dark-coloured and very heavy, and in some districts have almost a slatey character. In a recent paper upon these rocks, W. S. Bayley points out their distribution, and describes them from a chemical and petrographical point of view. He considers that the widespread occurrence of these peculiar rocks throughout all of the iron-bearing horizons of the Lake Superior region must possess some important significance. He does not commit himself, however, to any theory of their meaning.

An Official Telegraphic Dictionary.—The International Telegraphic Bureau of Berne is actively prosecuting a work which was begun three years ago—the compilation of an official vocabulary for telegrams in a language agreed upon for the purpose. The book, on which, amongst others, English, Dutch, and Spanish functionaries have laboured, will, says the *Financial Times*, comprise at least 240,000 words, selected from the English, German, French, Italian, Spanish, Latin, Portuguese and Dutch languages. It is said that the composition will be complete by next March, when it will be immediately issued for sale. Not for three years, however, will it be in general use. The International Telegraphic Congress, which will take place at Buda Pesth in 1896, may possibly recommend the Postal Union to adopt it.

Magnetic Rotation Data.—Some important measurements have recently been made by O. Schönrock of the magnetic rotation of the compounds used by Landolt and Jahn in their investigation of dielectric constants (Berlin *Sitz. Berichte*, July 21st, 1892). The list of compounds includes water, a large number of hydrocarbons, alcohols, and other organic substances. These measurements are given in a table which may be consulted in the *Zeitschrift für Physikalische Chemie*, xi., pp. 753—786. In order to investigate the influence of electrolytic dissociation on the magnetic rotation, Schönrock measured the constants of various salts dissolved in water and other solvents; but as most of the experiments were made with mercury salts, which are very slightly dissociated even in aqueous solutions, these results cannot be held to be conclusive. The aforesaid measurements, however, may be trusted.

Boundary Phenomena in Juxtaposed Solutions.—Faraday showed that if in the two limbs of a U-tube layers of pure water are placed above a saturated solution of magnesium sulphate in such a manner that the liquids do not mix, and an electric current then passed, a precipitate of magnesium hydroxide will form at the boundary of the solution and the water which is below the negative electrode. Hermann found that zinc sulphate could be substituted for the magnesium sulphate. Kümmel repeated the experiments, using solutions prepared with gelatin, which solidified on cooling, in order to prevent admixture between the pure water and the salt solution. He also examined the behaviour of a number of other metallic salts, and came to the conclusion that the phenomenon is due to solid particles being carried mechanically from the negative electrode through the feebly conducting water by the electric current. G. H. Zahn has recently turned his attention to the changes which occur at the boundary between solutions of different concentration during the passage of an electric current. A separation of hydroxide was observed when the current was passed from the stronger to the weaker solution in the case of a large number of salts which yield insoluble hydroxides; whilst even when (as in the case of silver, sodium and potassium salts) soluble hydroxides are yielded, their presence could be detected in the region of the boundary by means of suitable magnets. Zahn is led to conclude that water plays some part in the electrolysis of salt solutions, but he is not at present able to give a clear account of the *modus operandi*.

Electric Mains in France.—In France, before permission is given to run any electric mains, some rather complicated regulations have to be observed. Up to the present when a main was to be laid down in a national, departmental, or simply a communal road, permission had to be obtained in the two first cases from the Commissioners of Public Streets and Roads, and in the third from the Commune. This question has been discussed a great deal lately, as electric lighting applications are now spreading so extensively. And very often the regulations may be interpreted in different ways. To prevent misunderstandings the Commissioners of Public Works have just issued circulars showing exactly the various conditions of these permissions in as liberal a sense as possible. We cannot reproduce all these circulars here. They are three in number, comprising a great many pages, but various French electrical journals have published them *in extenso*.

A New Electrolytic Reduction.—Aromatic nitro-compounds may now be reduced by electrolysis according to a method recently proposed by L. Gattermann (*vide Berichte*, xxvi., pp. 1,844—1,856), with the result that many new compounds may be conveniently produced. The nitro-compound is dissolved in five to ten times its weight of concentrated sulphuric acid, and the cold solution put into a porous cell, which stands in a vessel containing 75—100 per cent. sulphuric acid. The inner cell contains a platinum cathode, and the outer cell a platinum anode. A current of 1½ to 3 ampères at a potential of 5 to 6 volts is used. Heat is evolved during the reaction, and the products separate usually as sulphates, either at once or on setting aside in a cool place. If the product is very soluble in sulphuric acid, it is precipitated on the addition of water.

Electrical Facts Explain a Chemical Change.—Three different views are held by dyeing experts as to the nature of the change which takes place when pararocaniline is converted into one of its coloured salts; and there has been much controversy about it. It recently occurred to A. Miolati to apply what may be termed an electrical test in order to determine which view was the correct one. If one supposition was correct, the salt must be a non-electrolyte; whereas if either of the others held good, it must conduct electricity in the same manner as the metallic salts. Miolati found by experiment that a solution of the salt did conduct electricity, its molecular conductivity being about 46·5. Pararocaniline is therefore a stronger base, and its salts undergo electrolytic dissociation in aqueous solution. As Miolati points out, however, in the *Berichte*, xxvi., pp. 1,788—1790, this electrical test still leaves two suppositions between which it is unable to decide.

The Magnetic Concentration of Iron Ores.—Competition in prices invariably determines greater economy in production. There are many commodities which are only put upon the market at a profit because it has become possible to utilise waste or bye-products. An illustration of this may be found in the recovery of iron from its ores. Low grade ores used in the palmy days to be discarded as not worth working up; but it is different now. Necessity invented the process of magnetic separation, and circumstances are bringing it into extensive use. There is an interesting article on this subject in *Technology Quarterly*, 5 (1 and 2, 64—69), by H. S. Chare. He points out that in all concentration operations previous sizing is requisite, and that this is best effected by treatment of the ore in crushers, followed by rolls and screens. The fineness attained depends upon the size of the particles of magnetite as compared with those of the constituents of the "gangue." Crushing to pass a 20-mesh sieve generally suffices. But a finer product small enough to pass a 50-mesh sieve is often of advantage. Such fine stuff can be used in the blast furnace, but the expense of grinding is excessive. On account of this objection, and also of the fact that when grinding is coarse complete separation cannot be effected, it is now becoming customary to crush the ore coarsely first and put it through a separator which yields "tailings" free from magnetite, several "middle fractions" containing some magnetite and a "concentrate," consisting almost wholly of magnetite. The "middle fractions" are then re-crushed and again separated, the cost of crushing the whole of the ore to the fineness necessary to allow of the removal of the smaller particles of magnetite being thus saved.

Llandrindod Well and Electric Lighting.—The Local Board have consulted an "eminent electrician" regarding the electric lighting question. This gentleman (Mr. T. Preece) recommends an expenditure of £2,000.

Holborn Town Hall Lighting.—Dissatisfaction having been expressed with the quality of the electric light at this Town Hall, the company were referred to. The explanation given by them is, that the light required to be supplied from Sardinia Street Station exceeded the installation power, and the deficiency could not be remedied until another station was erected. We understand that the company are endeavouring to secure a suitable site.

NEW COMPANIES REGISTERED.

Dover Electricity Supply Company, Limited (39,779).—This company was registered on the 18th inst. with a capital of £50,000, in £5 shares, to carry on the business of electrical engineers, electricians and contractors, suppliers of electricity, manufacturers of electrical apparatus, mechanical and chemical engineers, and of supplying light, heat, sound and power by electricity, galvanism, magnetism, or otherwise. The subscribers (with one share each) are:—B. Broadhurst, Minerva Road, Kingston-on-Thames, secretary; G. A. Zeden, Shandon Lodge, Coventry Park, S.W., electrical engineer; F. Hodson, 161, Kennington Road, S.E., accountant; F. E. Beeton, 76, Woodhouse Road, N.W., accountant; R. P. Sellon, 49, Queen Victoria Street, E.C., engineer; W. D. Brightman, 7, Queen Anne Terrace, N., accountant; A. J. Lawson, 63, Bedford Gardens, W., electrical engineer. There are not to be fewer than three nor more than seven directors. Qualification, £500. Remuneration, £500 per annum. Registered office, 49, Queen Victoria Street, E.C.

English Electric Manufacturing Company, Limited (39,796).—This company was registered on the 23rd inst. with a capital of £5,000 in 4,000 ordinary and 1,000 preference shares of £1 each. To carry on business of electrical and mechanical engineers, merchants, and manufacturers of, and dealers in electric, galvanic, magnetic, telegraphic, and other appliances. The subscribers (with 1 share each) are: M. James St. Clair Griffin, 59, Hall Lane, Liverpool, gentleman; J. H. Hirst, Holmedene, West Hill, Huddersfield, commercial traveller; J. Hales, 63, Granby Street, Leicester, newspaper proprietor; A. Anderson, 20, Railway Walk, Buddale, Southport, commercial traveller; J. W. Parsons, Roath, Cardiff, reporter; T. H. Lloyd, Mansfield, Notts, traveller; M. A. Hales, Leicester, hotel proprietor. Registered, without articles of association, by Jordan and Sons, 120, Chancery Lane, W.C. Registered office, 30, Stamford Street, Leicester.

Canterbury Electricity Supply Company, Limited (39,780).—This company was registered on the 18th inst., with a capital of £50,000, in £5 shares, to carry on the business of electrical engineers, electricians and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, or otherwise. The subscribers (with 1 share each) are:—B. Broadhurst, Minerva Road, Kingston-on-Thames, secretary; G. A. Zeden, Shandon Lodge, Coventry Park, S.W., electrical engineer; F. E. Beeton, 76, Woodhouse Road, N.W., accountant; F. Hodson, 161, Kennington Road, S.E., accountant; R. P. Sellon, 49, Queen Victoria Street, E.C., electrical engineer; W. D. Brightman, 7, Queen Ann Terrace, N., accountant; A. J. Lawson, 63, Bedford Gardens, W., electrical engineer. There are not to be fewer than three, nor more than seven directors. Qualification, £500. Remuneration, £500 per annum. Registered office, 49, Queen Victoria Street, E.C.

Cycle and Electro-Plating Company (Saville's), Limited (39,774).—This company was registered on the 18th inst. with a capital of £5,000, in £1 shares, to acquire and carry on the business of cycle manufacturers, repairers, agents, and electro-platers, now carried on by James Saville at Middlesborough, Yorks, under the style of James Saville and Co. The first subscribers (with one share each) are:—E. Liddle, Dundas Street, Saltburn-by-the-Sea; N. Allan, The Ferry, Middlesborough; J. Saville, 52, Corporation Road, Middlesborough; W. Tennet, 66, Corporation Road, Middlesborough; W. A. Thubron, Lime Street, Saltburn; F. Burr, 21, Russell Street, Middlesborough; F. Knox, 79, Corporation Street, Middlesborough. The first directors are: E. Liddle, W. A. Thubron, A. Chilton, J. Walker, W. A. Knaggs, and J. Saville. Qualification, £50; remuneration not yet determined. Registered by Jackson and Jackson, 61, Lincoln's Inn Fields, W.C.

Cube Sugar Company, Limited (39,766).—This company was registered on the 17th inst. with a capital of £18,000 in £1 shares; to carry on the business of manufacturers of cube sugar, and to acquire the plant, machinery and materials therefor; and to carry on the business of mechanical and electrical engineers, or any other undertaking in connection with any inventions or processes in which the company may be interested. The subscribers (with one share each) are: F. E. Hancock, 7, Smith Square, S.W.; J. Pye, 32, Cheapside, E.C.; S. Barclay, 95, Farringdon Street, E.C.; A. H. Thorne, Wells Street, W.; F. W. Serjent, St. Peter's Park, W.; G. Brown, Tottenham; and F. C. Morgan. There are not to be fewer than three nor more than seven directors; qualification, £300; remuneration, £150 per annum each, payable only out of the net profits. Registered by H. C. Harrington, 95, Farringdon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric Light Regulating Syndicate, Limited.—The statutory return of this company shows that out of a capital of £1,000, in £1 shares, 865 shares have been taken up. A sum of £1 has been called up on 240 of these, and paid, and £625 has been considered as paid.

United Asbestos Company, Limited.—This company has filed its return for the year 1893, which shows that out of a nominal capital of £140,000, in 4,118 6 per cent. £5 preference, 1,000 £10 preference, 10,000 £5 ordinary, and 10,000 £5 deferred shares, 9,975 "A" ordinary, with £5 paid, 9,975 "B" deferred, with £5 paid, 997 10 per cent. preference, with £10 paid, and 4,118 6 per cent. preference, with £5 paid, have been taken up. The total amount of calls received is £80,535, and that considered as paid £49,875. There is £25 outstanding, and £225 has been forfeited on 50 shares.

United Electricity Supply Company, Limited.—This company is being wound up under clause 7 of the Companies' Acts, 1880, by notice in the *London Gazette*, dated August 15th, 1893.

Western and Brazilian Telegraph Company, Limited.—The 1893 return of this company has been filed at Somerset House. From this it appears that out of a nominal capital of £1,500,000, in 66,871 £15 and 66,258 £7 10s. shares, 130,500 have been taken up. A sum of £15 has been called on 64,242 shares, and £7 10s. upon the remaining 66,258 shares. The total amount of calls received reaches £1,460,565, and £565 has been forfeited on 75 shares.

Weston-super-Mare Electricity Supply Company, Limited.—On the 15th of last August the *London Gazette* notified that this company had been dissolved under clause 7 of the Companies' Act, 1880.

Weymouth Electricity Supply Company, Limited.—According to a notice filed at Somerset House, this company has, by notice in the *London Gazette* on the 15th of last August, been dissolved, under the 7th clause of the Companies' Act of 1880.

Windsor and Eton Electric Light Company, Limited.—This company is, by a resolution passed a few weeks ago, being wound up voluntarily, and Mr. Wm. Sevenoakes, the secretary, is acting as liquidator.

Home Telephone Company, Limited.—From the latest official return of this concern, it appears that 100 shares (with £2 called on each) out of a nominal capital of £500, in £5 shares, have been taken up. A sum of £200 has been paid on this account.

Wyndham Electric Light Company, Limited.—The return of this company for 1893 shows that out of a nominal capital of £1,500, in £1 shares, 885 shares have been taken up. A sum of 15s. has been called on each of 635 shares, and £250 has been considered as paid. The total amount of calls received reaches £199 15s., and £276 10s. is yet unpaid.

Yorkshire House-to-House Electricity Company, Limited.—The annual return of this company shows that out of a capital of £100,000, in 19,900 ordinary and 100 founders' shares of £5 each, 7,328 ordinary, with £4 10s. paid, and the whole of the founders', with the full amount paid, have been taken up. The total amount of calls received is £32,530, that agreed to be considered as paid £500, and that still outstanding £592 10s.

Head, Wrightson & Co., Limited.—This company has lately filed its annual return, from which it appears that the whole capital of £210,000, in £5 shares, has been taken up, and paid in full. An amount of £24,270 is still outstanding in respect of share warrants, and share warrants representing 25 shares have been surrendered during the past year.

Veale & Co., Limited.—The annual return of this company, filed at Somerset House on the 17th inst., shows that out of a nominal capital of £10,000, in £1 shares, 4,904 shares have been taken up. On 1,065 of these £1 has been called. An amount of £1,065 has been received, and £3,839 has been agreed to be considered as paid.

Metropolitan Electric Supply Company, Limited.—The last annual return of this company shows that, out of a nominal capital of £500,000, in 49,900 ordinary and 100 founder's shares of £10 each, the whole capital has been taken up. A sum of £10 has been called on 47,868 ordinary shares, and 2,132 of these were issued as fully paid. The total amount of calls received reaches £478,421 9s. £21,320 has been agreed to be considered as paid, and £258 11s. remains unpaid.

Ruston, Proctor & Co., Limited.—According to the last annual return of this company, it seems that the nominal capital was £250,000, in 25,000 £10 shares. The whole of these have been taken up, and £10 has been called on 17,500 of them. The total amount of calls received reaches £175,000, and £75,000 has been agreed to be considered as paid.

Reading Electric Supply Company, Limited.—This company filed its annual return on August 31st last, and that document shows that out of a nominal capital of £75,000 in £5 shares, only seven shares have been taken up. There has been nothing called or paid.

Richmond (Surrey) Electric Light and Power Company, Limited.—This company has lately filed its last annual return. From this we learn that out of a nominal capital of £50,000 in £5 shares, only seven shares have been taken up. There has been £35 paid in respect of these.

Babcock & Wilcox, Limited.—The annual return of this company has been made up to September 17th, and it shows that the whole of the nominal capital of £240,000, in 10,000 £6 per cent. cumulative preference and 14,000 ordinary shares, all of £10 each, has been taken up. Out of these, 7,999 shares were issued as fully paid; and a sum of £160,010 has been remitted on the remaining shares.

Column Printing Telegraph Syndicate, Limited.—A short time ago this company filed its annual return at Somerset House, from which it appears that out of a nominal capital of £25,000, in 500 shares of £50 each, 229 have been taken up. As many as 100 of these have been considered as fully paid; and the full amount has been called on the remaining shares. The total result is shown as £5,550; and there is a sum of £900 in arrear.

Chloride Electrical Storage Syndicate, Limited.—The annual return of this concern, made up to the 28th of last July, has been filed quite recently. The nominal capital is £262,500, in 110,000 "A," 140,000 "B," and 12,500 founder's shares, all of £1 each. It appears that 65,230 "A," 100,000 "B," and the whole of the founder's shares have been taken up. As many as 45,000 "A," 100,000 "B," and all the founder's shares, were issued as fully paid. Upon the remaining 20,230 "A" shares the whole sum has been called and paid.

CONTRACTS OPEN AND CLOSED.

OPEN.

Derby—November 6th. For the wiring, provision, and fixing of the electric light fittings, the alterations to existing gas fittings where required, and the accessories of the whole or any of these for the electric lighting of the institution, for the Chairman and Board of Management of the Midland Deaf and Dumb Institution, Friar Gate, Derby. Copy of the specification and forms of tender may be obtained on and after 23rd inst., from Messrs. Bramwell and Harris, 5, Great George Street, Westminster, S.W.

Gateshead.—October 30th. The Gateshead Industrial Co-operative Society, Limited, invite tenders for a complete installation of the electric light for their Whitehall Road Branch, Gateshead. Specifications can be had from the secretary on a deposit of £1 1s. being made.

CLOSED.

Paddington Baths.—The Paddington Baths Commissioners have accepted the tender of Messrs. Dawson & Hammond, of John Street, Edgware Road, for fixing electric lighting apparatus in front of the platform in the large hall.

BUSINESS NOTICES, &c.

The Universal Electrical Directory (J. A. Berly's), now under the direct supervision of the proprietors, H. Alabaster, Gatehouse & Co., is in active preparation for the 1894 edition (13th year). This is a directory of the electrical trades embracing the whole Universe, and having no superfluous matter irrelevant to a directory it can be sent everywhere, carriage paid, for 4s. It is indispensable to all having business transactions in the electrical world, and once used cannot be done without. Advertise in it! Order it! It will prove the best outlay ever made.

Steamship Lighting.—On Thursday, the 12th inst., the new passenger ship *Zaire* went out on her trial trip from the River Tees. The vessel, which is built of steel to Lloyd's spar deck rules by Messrs. Sir Raylton Dixon & Co., of Middlesborough, to the order of the Empriza Nacional Steam Navigation Company, of Lisbon, is of the following dimensions: Length, 350 feet 6 inches; beam, 42 feet 2 inches; depth moulded, 28 feet 9 inches. A complete installation of electric light has been fitted throughout by Messrs. Paterson & Cooper, of London and Glasgow, under the direction of Mr. E. George Tidd, their engineer and manager in Scotland. The plant is very compact and consists of a Robey vertical inverted cylinder special electric light engine, capable of developing 35 H.P. with a steam pressure of 80 lbs. coupled direct on same bed-plate to one of this firm's new type of Phœnix dynamo. The size of cylinder is 9½ and 9 stroke; speed, 350 revolutions per minute. The dynamo, which is designed to give an output of 18,000 watts in the external circuit, is of the inverted type with wrought-iron field magnet and Gramme wound armature. The total number of lights fitted is 315, which are all of 16 C.P. with the exception of 22 fitted in the engine room and which are 50 C.P. each. The mast-head and side lights are also fitted with the electric light, the lanterns being of a special design as used by Messrs. Paterson & Cooper. The installation is divided into six circuits, viz.: saloon and first class, second class, third class, engine room, officers, and cargo clusters. The fittings in the saloon are made of real bronze metal, fitted with rich cut-glass globes, and which should wear much better than the ordinary plated fittings generally used in saloons. These fittings look very grand and have a beautiful effect against the marble decorations. The first-class accommodation is fitted with plated fittings with cut and etched glass globes, while the second-class has brass fittings with opal globes. These fittings are of the usual design which this firm use for ship work and are well suited for it. All the switches and fuses in these parts are of the tumler type, with covers to match the fittings in the various rooms, &c. The fittings in the engine room and other parts of the vessel, are of the usual substantial type as used by this firm in all their ship work. A complete system of electric bells has also been fitted throughout the ship by the same firm.

Electric Lighting of Iron Foundries.—Messrs. J. & R. Houston, engineers and ironfounders, of Greenock, have established the electric light at their Cartsburn and Glenburn foundries. The installation in the Cartsburn works consists of nine arc lamps of 2,000 candle-power (nominal), and from 60 to 70 incandescent lamps, ranging up to 100 candle-power. In the Glenburn works, which are about a quarter of a mile distant from Cartsburn, the lights consist of two arc lamps in the yard, and a number of incandescent lights in the drawing office.

Brewer's Exhibition.—Messrs. W. H. Willcox & Co. are exhibiting a large selection of engineer's stores and tools at the Brewer's Exhibition, and having taken over the Farringdon Patent Pumps, Patent Penberthy Injectors and Ejectors, also Sight Feed Lubricators, Steam Cocks, &c., from Messrs. Pontifex & Wood, Limited, of Shoe Lane, London, who have given up this particular business to them. They also show a selection of engine packings, India-rubber goods, various oils, also the usual assortment of engineering sundries.

Failure of Day & Company.—Under the receiving order recently made against Joseph Day and Jules Dent Young, mechanical engineers, trading under the style of "Day and Company," and carrying on business at Bath, a statement of affairs has now been lodged showing liabilities £27,505, of which £16,315 is expected to rank, and assets estimated to produce £17,728. The firm were manufacturers of the "Day" gas engine, which, it is not out of place to state, is an engine of considerable merit. They attribute their failure immediately to pressure by creditors and consequent inability to realise their interest in valuable patents. The insolvency is also accounted for by losses through bad debts and depreciation in investments during the last ten years, amounting to about £5,000. The unsecured liabilities include claims amounting to nearly £9,000 in respect of borrowed moneys and bills discounted. The securities held by creditors treated as "fully secured" (£16,500) are stated to represent charges on patents and mortgages on the lease of the debtors' premises at Spring Gardens, Bath. The creditors "partly secured" (£4,627) are stated to hold shares (estimated at £981), and guarantees and bills held by the bank. Other property (£4,500) is stated to consist of stock of patterns, one moiety of the American patent of "Day's Gas Engine," and joint licence to manufacturers under syndicate. A scheme of arrangement has been lodged and will be submitted at the adjourned first meeting of creditors, which is fixed for the 27th inst.

Crystal Palace Lighting.—A change has just been completed in the lighting of the Crystal Palace, the Gülcher machines and lamps, which have done service for so many years, being replaced by three Crompton machines and 90 Crompton arc lamps. The prime motor remains the same, except that improvements have been made in the transmitting gear by a more effective arrangement of shafting, and the adoption of Bayshaw-Addiman clutches. The lamps are divided into nine circuits of ten each, three circuits being fed from each machine, and so arranged that a portion of the lamps throughout the entire building can be run from any dynamo. It was intended to cover the leads throughout the building with iron piping, but, this being objected to by the Fire Offices, the conductors are run through ordinary "Bright" insulators. We are afraid the Crystal Palace District Electric Supply Company will feel disappointed that they have not secured the Palace Company as customers, but we understand that careful calculation convinced the managers of the Palace that by far the most economical system open to them is to have their own plant. The work has been executed in the most perfect way by the engineer to the Palace Company, Mr. Carr, and his assistant, Mr. Wright (both of whom have had considerable experience of electrical work), under the direction and superintendence of Mr. W. H. Massey, as consulting electrical engineer.

A New Tramcar.—Last week, Major-General Hutchinson, R.E., visited Croydon for the purpose of inspecting, on behalf of the Board of Trade, a new tramcar, which is about to be used on the Croydon and Thornton Heath section of the Croydon and Norwood Tramways Company. It is known, says the *Times*, as the Lührig gas car, and is a German invention, propelled, as its name implies, by means of gas. It is self-contained and has a running capacity for about 15 miles. There is no smell or vibration and very little evidence of the waste gas going into the atmosphere. From experiments carried on by Prof. A. B. W. Kennedy, F.R.S, it has been found that in ordinary circumstances the cost of traction will be reduced by about 65 per cent. The gas is ignited by an electric spark, and the motive power, which consists of two double-action seven horse-power gas engines, is completely hidden, together with the fly-wheel, at the back of the seats. Major-General Hutchinson expressed his approval of the car and passed it, subject to the carrying out of certain minor alterations.

Advocates of Electric Light were Elected.—The public lighting of the town of Killarney is a matter of much local concern, so much so indeed that the municipal elections this year were fought out in that town on the issue of gas *v.* electric light. There were seven candidates nominated for four vacancies, and of these seven candidates four were nominated in the interest of electric light, while the remaining three were proposed and put forward in the interest of the gas light. The four candidates who were in favour of having the town lit by electricity were returned at the head of the poll.

Burglaries.—Burglars broke into Shillingford Electrical Works, Wallingford, the other day, and appropriated £6 or £7 cash from a draw in the office. No clue can be traced.

The latest pretence under which burglars sharply contrive to gain admittance to premises is that they are sent "to look after the electric light appliances." The police state for the past three years they have been on the look out for men of this special class. One man is now in custody charged with the offence.

Hampstead Electric Lighting.—On Tuesday last week a number of members of the Electric Lighting Committee of the Hampstead Vestry paid a visit of inspection to the works of Messrs. Siemens Bros. & Co., Limited, electrical engineers near Woolwich. Messrs. Siemens are the contractors for carrying out the electric lighting works. On arrival at the works the visitors were entertained at luncheon, at which Mr. Alexander Siemens presided, and afterwards they were conducted through the various shops and factories.

Towcester Electric Lighting.—Efforts are being made to introduce the electric light into this town, and a few days ago the inhabitants were canvassed as to whether they would adopt the new light. A local paper says that the electric light will be supplied at the "rate of 1s. per 1,000 less than the present price of gas, which is said to be 5s. 9d." Signatures have been obtained for about 800 lights from the principal shopkeepers in the town, whilst Sir T. G. F. Hesketh, Bart., of Easton Meston House, will require another 100.

Huddersfield.—A prominent feature of the Corporation electric lighting in this town is the lighting of the Town Hall and Municipal Buildings attached. The electroliers and ornamental fittings, generally, were entrusted to Messrs. Winfields, Limited, of Cambridge Street Works, Birmingham, and 49, Farringdon Street, London, and at the opening ceremonies recently reported in our columns, the general arrangement and graceful designs were pronounced an entire success. Messrs. Winfields are very busy in their electrical department, and have the fitting up of several churches, &c., in hand.

Bradford Electric Lighting.—The income from the electricity department during the past year was £8,399, and the expenditure £3,913. This shows a profit on trading account of £4,486. Against this is the net sinking fund and interest charges, amounting to £2,863, leaving a net profit of £1,623 for the year. Up to the beginning of the past year the working of the department had resulted in a net profit of £1,623, leaving an amount of £1,269, which may be appropriated as the council deem advisable.

Fleetwood Electric Lighting.—The proposed electric lighting station is to be erected in the Town's Yard; the present street lamps are to be used "as far as possible" for electric lighting, and the requisite alteration to lamps are to be included in any scheme that may be submitted to the Board. The low-tension system with accumulators is to form part of the scheme, and the motive power is to be obtained by means of producer gas, working suitable gas engines.

Electric Light at Stockton.—The first application in Stockton of electricity for illuminating purposes is being made by Mrs. Stanton, in her large boot and shoe establishment. The installation has been carried out by Messrs. Ernest Scott & Mountain, of Newcastle. The motive power will be supplied by a six horse-power nominal Otto gas engine, and the most conspicuous lights will be three 2,000 candle-power arc lamps on the front of the premises.

An Improved Arc Light.—In an article under this heading some weeks ago, we described a "new incandescent arc lamp" which was brought before the Chicago Congress of Electricians. There has now been forwarded to us by the Royal Arc Electric Company, of New York, which company have apparently taken up the manufacture of the lamp, a framed illustration of it.

Restaurant Lighting.—One of the most exquisitely furnished, complete, and lavishly fitted hotels that has been opened lately is that situated at 76, Strand, W.C., *i.e.*, the Club Café, where on Wednesday the directors of the company held a "Press reception." The place is fitted throughout with incandescent lamps, and customers are permitted free use of the telephone, Exchange Telegraph Company's machines, and many other advantages.

Hamilton and Electric Lighting.—At a meeting of the local authority last week, an application of the Caledonian Electric Supply Company, Limited, came up for consideration. This application was that the company should be allowed to apply for a provisional order. The board, however, decided to apply for an order themselves.

Change of Address.—Owing to the continual steady growth of their business, Messrs. Lund Brothers & Co., have removed from 355, Oxford Street, W., to larger premises at 123 and 125, Oxford Street, W. (corner of Wardour Street), where, in addition to the offices they have a large show-room on the first floor.

Edinburgh Electric Lighting.—The Electric Lighting Committee have resolved to take power to shut up St. Cuthbert's Lane in that part formed by the triangle of St. Cuthbert's Lane, Dewar Place, and Torphichen Street. This step is necessitated by the contemplated electric lighting depôt.

Electric Light at a Manchester Library.—The Reference Library, King Street, Manchester, which was opened on Monday last, is fitted up with the electric light. In the chief reading-room there are 10 arc lamps, while the lower reading-rooms are also electrically lighted.

South Staffordshire Electric Tramways.—A few weeks ago Mons. Gerrard, Chief Minister for Railways, Telegraphs, and Post Office for Belgium, paid an official visit to inspect these tramways on behalf of the State authorities of his country.

Electric Lighting in Private Carriages.—Messrs. J. Buchanan & Co., coachbuilders, of Glasgow, have just completed a new brougham, in which the electric light has been introduced inside and outside.

Dewsbury Workhouse Electric Lighting.—A "specialist on electrical installations" is to be called in to advise the Board of Guardians regarding the electric lighting of the workhouse premises.

The Electric Staff System.—Last Sunday the working of the electric staff system was commenced on the Severn Valley line of the Great Western Railway at Bridgnorth.

Sunderland Electric Lighting.—Dunning Street Hospital and the ground adjoining are to be appropriated for the purposes of an electric lighting station.

London Metallurgical Company, Limited.—Mr. J. D. S. Bogle, of Bourne House, Copthall Avenue, has been appointed liquidator of this company.

Church Lighting.—The church of St Mary-at-Hill, London, is shortly to be lighted with the electric light.

Bankruptcy.—The first meeting in the bankruptcy proceedings of William Andrews, electrician, of 6, St. Ann's Valley, late 118, Hunger Hill Road, Nottingham, was held at the Official Receiver's, on 20th inst. The examination will be opened on November 3rd at 10 o'clock.

Electric Lighting of Insurance Offices.—We notice that Messrs. Drake & Gorham have obtained the contract for the lighting of the Rock Life Insurance Company's offices, New Bridge Street, where there will be about 120 lights of 16 C.P.

Club Electric Lighting.—The members of the Liverpool Junior Reform Club are clamouring after the electric light for their premises, and have urged the matter forward for the consideration of a committee.

Derry Electric Lighting.—The electric lighting operations are being pushed forward speedily. Several miles of mains have been laid, and very soon one of the circuits will be completed.

CITY NOTES.

The Brighton and Hove Electric Light Company, Limited.

THE directors of the Brighton and Hove Electric Light Company, Limited, have issued a prospectus setting forth a proposed scheme of reconstruction of the company. This is in accordance with suggestions made by the Debenture Holders' and Creditors' Committee. The subscribed capital and liabilities of the old company are:—Ordinary £5 shares, £15,005; first mortgage debentures, £15,000; unsecured liabilities, about £8,500. These are to be dealt with in the new undertaking as follows:—

PRESENT SHAREHOLDERS, £15,005. Reduction of £15,005 to £7,505, shares to carry profits after debentures and preference share claims for interest have been met.

CREDITORS, about £8,500. These to have allotted to them second preference shares to the value of claims; entitled to 6 per cent. after debentures and first preference have been dealt with.

DEBENTURES, £15,000. Half holding to be surrendered, viz., £7,500, and in exchange to receive £7,500 6 per cent. first preference shares, in addition to shares for arrears of interest.

NEW SUBSCRIBERS, £5,000. Subscribers wanted for new capital on prior lien 6 per cent. debenture bonds. To rank as a first charge on the property of the company.

These items, together, make the total capital of the company, as reconstructed, £37,005.

The £5,000 to be raised as above is to enable extensions to be carried out, and alterations to the plant to be effected, &c.

The business is to be continued as a going concern. It is said that the old company has been handicapped through want of sufficient capital to cope with an increasing business, and the present difficulties have necessitated the appointment of a receiver for the debenture holders. The present position, therefore, impedes for the moment the recent progressive tendency of the company; but it is considered that should the reconstruction be successful, the business would be a very profitable one. Should the full capacity of the plant be taken up, the net profit would be £2,000 a year or more, whereas the total interest and dividends on the debentures and preference shares at the rates mentioned would amount to £1,770. A comparative tabular statement is given by the directors, from which may be gained an idea as to the growth of the company from its inception:—

STATEMENT OF LAMPS CONNECTED TO MAINS.

(On the basis of 32 watts per 8 candle-power lamp.)

	1891.	1892.	1893.
January ...	6,426	9,619	15,563
February ...	6,570	9,873	15,624
March ...	6,688	10,320	15,824
April ...	6,953	10,531	16,027
May ...	7,061	10,605	16,195
June ...	7,170	10,625	15,971
July ...	7,588	11,310	16,262
August ...	7,948	12,898	16,294
September ...	8,168	14,713	16,478
October ...	8,420	14,977	—
November ...	9,041	15,541	—
December ...	9,498	14,868	—

STATEMENT OF ELECTRICITY REGISTERED BY THE CONSUMERS' METERS.

	1891. Units.	1892. Units.	1893. Units.
January ...	12,602	16,535	28,072
February ...	9,110	13,603	21,672
March ...	8,087	10,707	19,061
April ...	5,875	8,400	11,809
May ...	4,594	4,911	8,990
June ...	2,938	3,727	8,246
July ...	4,402	5,172	9,576
August ...	4,401	8,290	11,000
September ...	6,707	12,500	16,405
October ...	13,769	18,796	—
November ...	16,678	26,818	—
December ...	18,630	31,652	—

The directors for the new company are to be appointed by the shareholders, one director by each class of shareholders.

Montevideo Telephone Company.

THE report of the directors of the above company for the year ending July 31st last shows a net profit of £6,896, which, including the amount brought forward, leaves an available balance of £8,775, after providing for all working expenses in Montevideo and London, and after writing off £49 for proportion of preliminary expenses and £35 for depreciation of furniture at head office and in Montevideo. A comparison of the present accounts with those of last year shows a decrease of 1,100 in the working expenses at Montevideo and of £275 in the London office expenses, making together a decrease in expenses of nearly £1,400, while the falling off in the total value of subscriptions is only £700, and the net profit for the twelvemonth, after making ample allowance for bad and doubtful debts, is close on £500 more than for the preceding like period. Considering the continued state of depression prevailing in business circles in Montevideo during the whole of the period under review, the directors consider these figures satisfactory under the circumstances. The central premises in Montevideo have now become the unencumbered property of the company, the final instalment of the purchase money having been paid on March 6th last. The total sum paid out of this year's earnings for purchase money and interest is £5,504, and in addition to this expenditure it has been deemed expedient to open up a new branch to Barra, a small hamlet distant about 10 miles from Montevideo, at the mouth of the River Sta. Lucia, and other new lines have been laid at the request of the subscribers, so that the total outlay for improvements and additions to the property stands at £1,637, making together £7,141 paid out of the revenue. The directors do not, therefore, think it advisable to declare any dividend, and they recommend that £5,000 be placed to reserve account, that £3,000 be added to depreciation fund, and that £775 be carried forward.

Eastern Extension, Australasia and China Telegraph.

THE report of the directors for the half-year ended June 30th last states that the gross receipts, including Government subsidies, have amounted to £257,986, against £246,988 for the corresponding half-year of 1892. The working expenses, including £21,649 for cost of repairs to cable and expenses of ships, absorb £78,230, against £79,281 for the corresponding period of 1892, leaving a balance of £179,756. From this is deducted £3,969 for income tax, £32,171 for interest on debentures, debenture stock, contribution to sinking fund and special expenditure, leaving £143,617 as the net profit for the half-year. Two quarterly interim dividends of 1¾ per cent. each, amounting to £62,500, have been paid for the half-year under review, leaving £81,116 17s. 8d. to be carried forward. The working of the Australian tariff arrangement for the second year of guarantee ended April 30th last, has resulted in a loss of £43,558 as compared with £55,040 for the first year, and in accordance with the terms of the agreement, one-half of the loss, or £21,779, has been made up by the guaranteeing colonies, and the other half borne by the associated companies.

Under the powers given to them by the articles of association the directors have elected Sir Albert J. Leppoc Cappel, K.C.I.E., to fill the vacancy occasioned by the death of Sir James Anderson. The directors report that the chairman having performed the duties of managing director since the death of Colonel Glover in 1881, without salary, they have added to the chairman's remuneration the salary formerly paid to the managing director, in consideration of the ever increasing duties and responsibilities falling upon the management. The company's maintenance ships have, as usual, been employed on various cable repairs during the half-year under review, but, owing to most of the cables being duplicated, the revenue has in no instance been materially affected.

The Indo-European Telegraph Company, Limited.—The board of directors of this company have declared an interim dividend for the half-year ended June 30th last, at the rate of 5 per cent. per annum, free of income tax, payable on and after the 1st proximo.

Callender's Bitumen, Telegraph and Waterproof Company, Limited.—The directors have declared an interim dividend, payable on November 1st, at the rate of 10s. per share.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 22nd, 1893, amounted to £807; week ending October 23rd, 1892, £865; decrease £58; total receipts for half-year, 1893, £12,918; corresponding period, 1892, £12,620; increase £298.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 20th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £3,498.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation, October 18th.	Closing Quotation October 25th.	Business done during week ended October 25th, 1893. Highest.	Lowest.
184,500£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100—103	100 —103	...	...
1,134,640£	Anglo-American Telegraph, Limited	Stock	45 — 47 xd	43 — 45	45⅜	45⅛
2,932,680£	Do. do. 6 p. c. Preferred	Stock	84 — 86 xd	80 — 82	84½	80½
2,932,680£	Do. do. Deferred	Stock	8 — 8⅛	7½ — 8	8⅜	7⅞
130,000	Brazilian Submarine Telegraph, Limited	10	12 — 12½	12 — 12½	12⅜	12⅛
18,700£	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	101¼	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	107 —111	...	..
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅜ — 3	2⅜ — 3⅛	3	2 1/16
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2⅛ — 2⅜	2⅛	2 3/16
125,000£	Do. do. 4½ per cent. Debenture Stock	Stock	107 —109	107 —109	108⅜	...
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	4⅜— 5⅛	4⅜— 5⅛	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 — 3	2 — 3	...	...
630,000£	City and South London Railway	Stock	30 — 35	30 — 35	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11½— 11⅝	11½—11⅝	11⅝	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12⅝— 13	12⅝— 13⅛	13⅛	12 13/16
10,000,000$	Commercial Cable, Capital Stock	$100	135 —140	135 —140	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	10/-	1/16— 3/16	1/16— 3/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	3½ — 4⅛	3½ — 4⅛	...	...
50,000£	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	96 —101	96 —101	...	...
16,000	Cuba Telegraph, Limited	10	11 — 12	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	18	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½— 3⅛	2½— 3⅛	...	...
6,000	Do. do. 10 p. c. Preference	5	8½ — 9½	8½ — 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜— 11⅝xd	11 — 11¼	11⅜	11
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜— 15½xd	14⅜— 15	15½	14 13/16
70,000	Do. 6 p. c. Preference	10	16 — 16½xd	15½— 16½	16¼	15 11/16
105,900£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	108 —111	108	...
1,294,100£	Do. 4 p. c. Mortgage Debenture Stock	Stock	114 —117	115 —118	117	115⅜
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15½— 15⅝xd	15 — 15¼	15⅜	15
62,700£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	103¼	...
222,800£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	112 —115	113 —116	114⅜	112⅜
108,700£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
146,800£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	...	...
300,000£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
200,000£	Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000	25	104 —107 %	104 —107 %	106	...
49,900	Electric Construction, Limited, Nos. 101 to 45,100	10	1⅜— 2¼	1⅜— 2¼	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/8— 1/4	1/8— 1/4	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/8— 1/4	1/8— 1/8	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1/8— 1/8	1/8— 1/8	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1 — 2	½ — 1½	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜— 9⅝xd	8⅝— 8⅞	9⅜	8⅝
180,042	Do. do. 6 p. c. Preference	10	15½ — 15⅝xd	15 — 15¼	15⅜	15⅛
150,000	Great Northern Tel. Company of Copenhagen	10	20 — 20½	20 — 20½	...	...
200,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	103 —106	103 —106	...	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½— 5½	4½— 5½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 — 7	6 — 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½— 22½	21½ — 22½	22¼	22
200,000£	Do. do. 4½ p. c., Deb., 1896	100	101 —103	101 —103	...	...
17,000	Indo-European Telegraph, Limited	25	40 — 43	41 — 44	42¼	41¼
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1 — 2	1 — 2	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4⅛ — 4¼	4⅛ — 4¼	4 7/16	4 1/16
15,000	Do. do. fully paid	5	6 — 6¼	6 3/16— 6 7/16	6⅜	5⅞
37,500	Liverpool Overhead Railway Ordinary, fully paid	10	5⅛— 5⅜	5⅛— 5⅞	8¼	4⅜
6,295	Do. do. Pref., £6 paid	10	6 1/16— 6 3/16	6 1/16— 6 3/16	6⅜	...
37,548	London Platino-Brasilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000£	Do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	..
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6⅞— 7¼	7 — 7⅛	7⅛	7
50,000£	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	104 —107	104 —107	106	...
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	1½— 2⅛	1½— 2⅛	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	3 — 4	3 — 4	...	...
424,597	National Telephone, Limited, Nos. 1. to 438,984	5	4⅝— 4⅞	4⅝— 4⅞	4⅞	4 11/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	14 — 15	13½ — 14½	14	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½ — 14½	13½ — 14½	14½	...
113,234	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5½— 5⅝	5½— 5½	5 7/16	5⅜
726,477£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	112 —114	113 —115	114	113⅜
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,452	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5 — 6	5 — 6	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16— 5/16	3/16— 5/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	101 —104	102 —105	...	...
11,802	Reuter's Limited	8	5½— 6½	5½— 6½	...	...
19,980	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	6½— 6⅝	6 — 6½	6½	6¼
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8¼	...
3,381	Submarine Cables Trust	Cert.	115 —120	113 —118	...	...
78,942	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	2 — 2⅛	2 — 2⅛	2⅛	...
37,350	Telegraph Construction and Maintenance, Limited	12	31 — 33	32 — 34	33	32⅜
150,000£	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2 — 2⅛	2 — 2⅛	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½— 6½	5½— 6½	...	...
260,900£	Do. do. do. 5 p. c. Debentures	100	98 —101	98 —101	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	99 —103	99 —103	...	...
64,242	Western and Brasilian Telegraph, Limited	15	6¾— 7¼	6¾— 7¼	7⅛	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5 — 6½	5 — 6½	6⅛	5⅞
33,129	Do. do. do. 5 p. c. Deferred	7½	1½— 1¾	1½— 1⅝	...	...
178,200£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	...	...
222,700£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	..
88,321	West India and Panama Telegraph, Limited	10	1½— 1⅝	1½— 1⅝	1⅝	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10⅜	10
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 —10	9 — 10	...	...
80,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	106 —109	106 —109	...	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	115 —120	115 —120	...	...
169,000£	Do. do. 6 p. c. Sterling Bonds	100	102 —105	102 —105	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5 — 5½	5 — 5½	5½	5

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), £—5½.—Brush Company, 4½ per cent. Debenture Stock, issued at 1 per cent. premium, 100—103.—Electric Construction Corporation 6 per cent. Debentures, 98—98.—Electric and General Investment, shares of £5 (£1 paid), 1⅝—2⅛.—Founders' shares, 200—235.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—House to House Company (£5 paid) 1½—2⅛.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅝—5⅞, 1st Preference Cumulative 6 per cent., £5 (fully paid £—6½.—Manchester, Edison and Swan Company 49 (£1 paid), ½—¾.—Queen Anne's Mansions Lighting and Heating 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3 per cent. (October 5th, 1893.)

THE DEVELOPMENT AND TRANSMISSION OF POWER FROM CENTRAL STATIONS.*

BY PROF. W. CAWTHORNE UNWIN, F.R.S.

IV.

HYDRAULIC TRANSMISSION.—HIGH PRESSURE SYSTEMS.

The Hull Hydraulic Power System.†—This was the first scheme for distributing power hydraulically to many consumers. The principal main is 6 inches in diameter and 1,485 yards in length. The joints were flanged joints, with a gutta-percha ring of the kind generally used since. The pumping station is arranged for four 60 horse-power engines, of which two have been erected. Each engine delivers 130 gallons per minute at 700 lbs. per square inch pressure, corresponding to 63·6 effective horse-power. There is an accumulator 18 inches in diameter and 20 feet stroke, loaded to 610 lbs. per square inch. The charges were originally intended to be £52 for one crane per annum, and less for several cranes in one warehouse. The charges are, however, by quantity of water supplied as measured by meter. The minimum charge is £8 per machine per annum. The charge by quantity of water used ranges from £8 per annum for 16,000 gallons, or less, to £200 for 1,200,000 gallons, with special rates for greater quantities. The following short table will give an idea of the way the charges are graduated:—

Consumption of water per quarter.	Charge per quarter.	Charge per 1,000 galls. supplied.
Gallons.	£ s. d.	Shillings.
4,000 or under	2 0 0	10·0
9,000 to 10,000	3 10 0	7·0
49,000 to 50,000	12 10 0	5·0
99,000 to 100,000	20 0 0	4·0
199,000 to 200,000	35 0 0	3·5
299,000 to 300,000	50 0 0	3·3

The charge in excess of 300,000 gallons per quarter is 2·5 shillings per 1,000 gallons. For 500,000 gallons per quarter, 2·5 shillings per 1,000 is charged for the whole supply.

The London Hydraulic Power Company.‡—An Act was obtained in 1871 for supplying hydraulic power in London. The rights conferred by the Act remained dormant until resuscitated by Mr. Ellington in 1882. The present company was constituted in 1884. In 1887, 25 miles of pressure main had been laid in London streets, and at the present time there are nearly 60 miles of pressure mains. These extend from the West India Docks and Wapping on the east, to Kensington on the west; from Mint Street, south of the river, to Clerkenwell and Old Street on the north.

There are three principal pumping stations—one at Falcon Wharf, a short distance east of Blackfriars Bridge (800 indicated horse-power); another at Millbank, Westminster (600 indicated horse-power); and one at Wapping (1,200 indicated horse-power). A fourth station, in the City Road, is in course of erection (1,200 indicated horse-power). The aggregate power of all the stations, when complete, will be 3,800 indicated horse-power, of which one-third is reckoned as reserve power, in case of repair or accident.

At Falcon Wharf and Millbank all the water is taken from the river, but it is filtered before it is pumped into the mains. At Wapping, part is taken from the London Dock, part from a well. After use by consumers it flows into the sewers. The power is available for use night and day all the year round. It is largely used for lifting machinery and for presses and pumps. The company claim that it can be used for electric lighting of particular establishments and for extinguishing fires. For this last purpose, Mr. Greathead's injector hydrant, or hydraulic intensifier, is applied; a small jet of water from the high-pressure mains is made to intensify the pressure of a larger jet drawn from the ordinary town mains. A fire stream so obtained is capable of reaching the top of high buildings without employing a fire engine. In 1892 there were 1,696 machines worked by pressure water from the company's high-pressure mains, consuming 6,000,000 gallons per week. The quantity of water used by each consumer is measured by a meter on the exhaust pipe of the machines driven. Parkinson's meter is most used. Siemens's turbine meter is used to some extent, but it is inaccurate under the sudden fluctuations of discharge which occur. Kent's positive meter is also used.

At Falcon Wharf there are four sets of compound pumping engines, capable of indicating 200 indicated horse-power. They are vertical, with one high and two low-pressure cylinders, and a pump plunger directly connected to each piston. At 200 feet of piston speed per minute, each set of engines will deliver 240 gallons per minute at 750 lbs. per square inch pressure into the accumulator. This corresponds to 120 effective horse-power. A nine hours' trial of one set of engines was made in 1887, the engine running at constant speed, and the coal used being Seaborne small coal. The boilers are provided with an economiser.

* Abstract of Howard Lecture delivered before the Society of Arts.

† See Robinson, *Proc.* Inst. of Civil Engineers, Vol. xlix.

‡ The account of the London Hydraulic System is taken partly from a paper by Mr. E. B. Ellington, *Proc.* Inst. Civil Engineers, Vol. 94, partly from the Reports of the Company.

TRIAL OF HYDRAULIC PUMPING ENGINES.

Total indicated horse-power	178·5
Piston speed, feet per minute...	221·4
Steam pressure, lbs. per square inch...	82·5
Evaporation (from and at 212°) per pound of fuel, lbs.	10·59
Feed water per I.H.P. hour, lbs.	19·79
Coal per I.H.P. hour, lbs.	2·19
Accumulator pressure, lbs. per square inch... ...	750
Effective horse-power, calculated from water pumped, allowing 5 per cent. slip...	139
Mechanical efficiency of engine	0·78
Water pumped per minute (gallons)...	265·7

The engines consume, in ordinary work, 2·93 lbs. of coal per indicated horse-power, which is greater than the result given above, in consequence of the fluctuation of speed.

There are two accumulators at Falcon Wharf, with rams 20 inches in diameter and 23 feet stroke. Each accumulator has a capacity of storage equal to 2·4 horse-power hours. The filters are Perrett filters, constructed by the Pulsometer Company. The filtering material is compressed sponge. It is cleansed every four to six hours, by reversing the direction of flow, and by alternately compressing and releasing the pressure on the sponge.

The pumping station at Wapping is a more recently constructed and larger station than that at Falcon Wharf.

In a test trial, the engines are stated to have worked with 14·1 lbs. of steam, and 1·27 lbs. of Welsh coal per indicated horse-power hour.

Charges for Pressure-water for Power Purposes.—The London Hydraulic Company make a minimum charge of £1 5s. per quarter per machine. For consumers using more than 3,000 gallons per quarter, there are graduated charges, of which the following short table gives a sample:—

Gallons used per quarter.	Charge.	Cost of pressure water per 1,000 gallons.
	£ s. d.	Shillings.
3,000 or under	1 5 0	8·3
10,000	3 10 0	7·0
50,000	12 10 0	5·0
100,000	20 0 0	4·0
200,000	31 5 0	3·1
300,000	42 10 0	2·8

For an excess over 300,000 gallons per quarter is charged at 2s. per 1,000 gallons. Consumers using more than 500,000 gallons per quarter are charged 2s. per 1,000 gallons all round. Rates are further reduced for still larger quantities, and the minimum rate is 1·5s. per 1,000 gallons.

With these charges, the cost of power for the kind of work for which an hydraulic system is best suited is small. Thus it is often less than one farthing per ton lifted 50 feet. On the other hand, it is necessary, for the purpose of this treatise, to consider the cost of power distributed by different methods on some common basis. It is almost unavoidable to take the cost of power exerted continuously through the working day. If the cost of power supplied by the Hydraulic Power Company is reckoned for machines working 3,000 hours per year, then the cost is larger than that of power obtained in other ways. The comparison of the cost so reckoned is instructive, although it may be, in fairness, pointed out that Mr. Ellington, in his paper, stated that he had never advocated the supply of power for continuous driving engines to any large extent.

To obtain one effective horse-power during 3,000 hours per annum, allowing an efficiency of 80 per cent. in the motor, 437,500 gallons of water are required. Hence a consumer taking 50,000 gallons per quarter would get the equivalent of 0·457 effective horse-power for 3,000 hours, and would pay for it at the rate of £109 per horse-power per annum. A consumer taking 300,000 gallons per quarter would get the equivalent of 2·743 effective horse-power for 3,000 hours, and would pay at the rate of £62 per effective horse-power per annum. A consumer taking 500,000 gallons per quarter would get the equivalent of 4·573 effective horse-power for 3,000 hours, and would pay at the rate of £43 15s. per effective horse-power per annum. It must be remembered that this is the cost for pressure-water only, and does not include meter rent or interest on the cost of the motors.

LOW-PRESSURE HYDRAULIC SYSTEMS.

The Zurich Works.—The Zurich installation is a complex and very interesting one.*

The fall available in the Limmat at the pumping station, and the available volume of flow, are as follows:—

	Fall.	Volume of water flowing in the river.	Gross water H.P.
	Feet.	c. ft. per sec.	H.P.
High water level in summer ...	4·92	2,295	1,300
Mean " " " ...	8·20	1,660	1,570
Low " " winter ...	10·50	1,059	1,280

* See Preller on "The Zurich Water Supply Power and Electric Works." *Proc.* Inst. Civil Engineers, Vol. cxi.

The effective power delivered by the turbines in the river is as follows:—

	H.P.
For pumping filtered potable water	237
Supplying motive power by pressure-water	128
Driving the wire-rope transmission	227
Supplying hydraulic motive power for electric lighting station	444
Total	1,036

There are two reserve steam engines of 300 indicated horse-power each, to provide for a deficiency of water-power.

At the pumping station there are eight pressure (Jonval) turbines, working up to from 96 to 100 horse-power, according to the state of the river. There are also two newer turbines, of about 175 horse-power each. The turbines have vertical shafts, and each pair drives, by bevil wheels, a common horizontal shaft, which runs at 50 revolutions per minute, in the case of the earlier turbines, and at 66 revolutions per minute in the case of the two last erected. From these shafts a horizontal main shaft, 328 feet in length, and running at 100 revolutions per minute, is drawn. To this main shaft any of the pumps may be coupled. The earlier turbines cost, with gearing, about £12 per horse-power, the two larger turbines about £7 per horse-power. There are at present in operation seven sets of horizontal double acting Girard pumps. The total pumping capacity is 8,143,000 gallons per day. The water for driving the turbines is obtained by a weir in the Limmat, which deviates the water into a canal formed by a longitudinal embankment in the river.

The Hydraulic Works and System of Hydraulic Power Supply at Geneva.—There is now in operation at Geneva one of the most remarkable hydraulic power stations in the world. The water of the River Rhone, near the point where it flows out of Lake Leman, is employed to drive a number of large low pressure turbines, giving a total of 4,500 effective horse-power. These turbines pump pure water obtained from the lake into two systems of mains. The older of these, termed the low pressure system—the pressure at the pumps being 160 to 200 feet—is an extension of a previously existing system of mains used for supplying potable water to the town of Geneva. The second system of mains, termed the high pressure system, the pressure at the pumps being 460 feet, supplies potable water to some districts not reached by the low pressure system; but it is specially intended to afford a supply of water for motive power purposes to the entire area of the town. The demand for water, both on the low and high pressure system, is a fluctuating demand, large during the day, and very small during the night. Hence if the turbines in the Rhone were employed solely in pumping into the mains, they would not be continuously working, and a large part of the water-power of the Rhone would be wasted. To meet this difficulty, an important storage reservoir has been constructed at Bessinges, about 4 kilometres from Geneva. The turbines pump water up to this reservoir at night, and at times when the demand for power for other purposes is insufficient to keep them fully employed. The energy derived from water flowing back from the Bessinges reservoir through the high pressure system, represents parts of the water-power of the Rhone which would necessarily have been wasted if this means of storage had not been provided.

The Motors used in Geneva.—The original motors used in Geneva were Schmid pressure engines, and these are still used for small powers. They use a quantity of water which depends on the speed only and not on the work done. Hence they are uneconomical with light loads. They are convenient and cheap, they can be run at any speed, and they act as meters of the quantity of water used. A counter on the pressure engine recording the number of revolutions, gives the means of ascertaining accurately the quantity of water used. At full load their efficiency is 80 per cent.

For all larger motors impulse turbines are used. The maximum efficiency of these is 75 per cent., and it is not much less with light loads. They occupy little space, and can be perfectly governed to constant speed by the ingenious relay governors of Messrs. Faesch and Piccard.

The Electric Lighting Station.—In 1887, the City Council came to an arrangement with a company for supplying electricity. It was part of the arrangement that the company should use pressure-water, supplied by the town, as motive power in all its installations. The pressure-water is supplied to the company by meter, at a price of 2 centimes per meter cube, with a minimum of 400,000 cubic metres annually. This is equivalent to a little more than £3 per effective horse-power per annum. The advantage to the town is that their pumping machinery can be run constantly, night and day, the energy, which would otherwise be wasted, being stored. The electric company, on the other hand, get power at a cheap rate, and their turbines being driven by high pressure, are convenient and cheap, and run at an extremely constant speed.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.*

FIRST DAY.—September 12th.

MORNING SESSION.

THE Association was called to order by the President, Dr. AUGUSTIN H. GOELET, and after the transaction of some routine business, the President delivered the annual address, taking for his subject

* Abstract of the proceedings of the third annual meeting held in Chicago, September 12th, 13th and 14th, 1893.

THE INFLUENCES GOVERNING THE PROGRESS OF ELECTRO-THERAPEUTICS.

He said that last year in a spirit of humour the Association had been referred to as a vigorous infant, but its vigour was readily explained when it was remembered that it boasts of three parents. In the beginning it was predicted that it would never prosper, but would die young—even before the completion of its first dentition. He thought, however, that its present state of health and prosperity was sufficient evidence that it was destined to a long life of great usefulness, and a ripe old age. He thought the inauguration of this Association marked an event in medicine quite as important as any that had occurred within the present century, because it established a recognised position for an important and long neglected branch of therapeutics. The need of such an Association was quite evident to anyone who had attempted to present technical papers upon electrical subjects at other medical societies where there is usually so much unreasonable opposition to electro-therapeutics that profitable discussion is impossible.

The work thus far accomplished he considered very creditable for so young an organisation, particularly as the field is entirely new, and in the beginning involved much uncertainty. He emphasised the fact that the methods adopted must bear investigation and the stamp of scientific reasoning. Results, he said, may be doubted, but methods based upon scientific laws could not be questioned.

Electro-therapeutics must contend with the natural opposition by the profession to every new inroad upon old and established methods. The fact that it is not more universally employed is due to a want of appreciation and was attributed to restricted medical education and unfamiliarity with electro-physics and electro-physiology. Some of the more progressive of medical schools, he was pleased to observe, were beginning to realise the necessity of teaching this branch of therapeutics. The imperfections of past methods which were certainly unscientific, likewise operated greatly against a proper appreciation of modern electro-therapeutics. This could be overcome by diffusing a more general knowledge of the true position occupied by electro-therapeutics, and its successful accomplishment depended greatly upon the character of the work done by the Association, and upon the personality of its members.

The progressive spirit of the Association was well shown by the fact that there were no less than six committees charged with investigating scientific questions having an important bearing upon the different branches of the subject. He regarded the admission of other scientists from the electrical world to membership in the Association a step in the right direction, and further evidence of its progressive nature.

He recalled the fact that within the past five years scarcely a year had elapsed without the development of some new and important feature involving the application of electricity in some one of its forms. As an instance of this, he cited the development of metallic electrolysis and its extensive application; also the alternating simonisdal current of D'Arsonval and the capabilities of the interrupted induced current obtainable from modern apparatus.

The important improvements that have been made within the past few years in induction apparatus, whereby an increased frequency of interruption and an increased electromotive force of the current was obtained, he thought deserved especial mention. The possibilities of this current from a therapeutic standpoint are quite beyond the conception of anyone who has not had a practical clinical experience with it.

The programme of the present meeting gave abundant evidence of the advanced thought and work which have characterised the Association ever since its inception, and it was evident that electro-therapeutics is steadily progressing towards an exact science.

Attention was directed to the fact that, though concerted effort for electro-therapeutics is still young, its influence upon the views prevailing in medicine is already distinctly manifest.

In conclusion, the president declared that by conjoint efforts electro-therapeutics would be brought to that scientific plane which would make its most strenuous opponents their most cordial supporters.

The next order of business was the reading of "Reports of Committees on Scientific Questions."

ON STANDARD COILS.

The chairman of this committee, Dr. WILLIAM JAMES MORTON, of New York, said that the subject was so large, and each month was bringing so many new facts, that it seemed premature to make a report as to what should constitute a standard coil. On motion, the committee was continued.

ON STANDARD METERS.

Dr. MARGARET A. CLEAVES, of New York, read a report of this committee. The report stated that a good meter should possess a clear, legible scale of long range, and should be so constructed that it could be easily read by the operator while at work; that although in itself a shunt is not disadvantageous, it is undesirable because of the possibility of its heating and thereby changing its resistance; that the instrument should indicate in all positions, and is preferable when constructed to indicate with the current passing in either direction; that it should be very portable; and lastly, that it should not easily get out of order. Instruments of the galvanometer type were considered to be inaccurate on account of the magnetic influence exerted by surrounding objects.

Then followed a detailed description of the nine meters which had been submitted to the committee for examination, and the tests to which these instruments had been subjected. The report concluded with the statement that in the opinion of the committee the two meters which most nearly fulfilled the requirements were the Weston

and the Kennelly meters, and the Association was urged to adopt at once a standard meter.

The report called forth a long and earnest discussion as to the advisability of adopting at present a standard meter. Some of the members were of the opinion that one of the meters especially recommended by the committee had not been sufficiently long before the profession to enable many of those present to pass intelligently upon its advantages or disadvantages, and they therefore deprecated hasty action. Others thought it was impossible to combine in any one meter all the points a meter should possess in order to render it a thoroughly reliable instrument for all kinds of clinical work; and they consequently favoured the adoption of two types of standard meters. It was also suggested that to avoid unnecessary discrimination the Association should adopt a type of meter as a standard rather than any one particular instrument. The report of the committee was finally accepted and the chairman of the committee continued.

On Static Machines.

Dr. Morton reported that in order to pursue their investigations systematically a number of questions had been sent out in a circular letter, but no responses had been received. The committee made the following recommendation: That electrostatic machines adapted to medical practice should not have less than four revolving plates, and that the diameter of these plates should not be less than 26 inches. The report of the committee was accepted and the committee continued.

On Constant Current Generators and Controllers.

Dr. W. J. Herdman, of Ann Arbor, read a carefully prepared report on this subject in which he considered in detail the work accomplished by the various batteries which had been submitted to him for examination. No secondary batteries had been submitted, and mention of one or two batteries which had only been very recently sent in was omitted for lack of time to make the necessary tests. On motion the report was accepted and the chairman of the committee continued.

On Electrodes.

Dr. A. Lapthorn Smith, of Montreal, read a report of the committee. The committee expressed the opinion that the best ground work of all electrodes is copper wire gauze, and that the connection is best made by copper wire soldered the whole length of the gauze and terminating in a binding post—that known as No. 632 (?)—which is largely used by telephone companies throughout the world. Clay was considered the best covering, as it was the only substance which could be rendered moist enough to conduct properly without at the same time soiling the patients' clothing. It should be half an inch thick and of the consistency of putty. Before each application it can be readily cleaned by washing its surface with soapsuds. The back of the electrode is insulated with common table oilcloth.

The committee recommended three sizes of dispersing electrodes, viz., each having a uniform length of one foot, and the width, 3, 6, and 9 inches respectively. It was desirable that these sizes should be given in the metric system. For active electrodes to be used with the positive pole the committee naturally selected platinum as the best, its one objection being its first cost. Where the applications are to be made to the surface of the body or to the interior of a cavity like the uterus, carbon is equally good, and for such purposes carbon beads can be threaded on platinum wire. Zinc is also a useful material for intra-uterine galvano-cauterisation. It should be connected with reophore by means of the standard binding post already mentioned. It was recommended that the conducting cords employed in electro-therapeutical work should be of the standard sizes and lengths used by the Bell Telephone Company.

For negative intra-uterine application a Simpson sound made a useful electrode, and its size should be stated according to the French scale. Where the surface of the electrode is necessarily very irregular, its area should be determined by ascertaining how much water it will displace. It will be well for manufacturers to stamp all electrodes with two numbers—one giving the French scale, and the other the displacement of water or the surface of the electrode.

The committee recommended that a standard insulating material be adopted, and that the standard screw should be No. 240 of the American gauge.

All electrodes should be washed with soapsuds after each application, and boiled for five minutes before being used again.

Dr. Morton supplemented this report by presenting certain electrodes which he had devised, and which had proven useful in his practice. The first was a rubber covering for dispersing electrodes. It was an elastic rubber cap which would slip over the various sized electrodes, and which formed a pocket around the electrode, thus catching the water which would otherwise leak out on the patients' clothing. The second instrument was a new cataphoric electrode. With the usual form of this electrode it had been found impossible to apply the desired quantity of the medicated solution to the electrode without increasing the thickness of the blotting-paper to such an extent that it interfered with and sometimes wholly prevents cataphoresis; for it is essential that the distance between metallic conduction and electrolytic conduction should be reduced to a minimum. To obviate this defect, Dr. Morton had an electrode made in the form of a hollow box of hard rubber, the bottom of the box being formed by a piece of block tin perforated with numerous small holes. The box is filled with the desired quantity of the medicated solution, which passes through the small openings in the tin bottom and is fed to a thin piece of blotting-paper on its lower surface. In this way any quantity of the solution may be employed without interfering in the slightest degree with the cataphoric action.

The third instrument exhibited was an Apostoli intra-uterine electrode insulated at the tip and at the cervical portion. In conclusion, the speaker referred to the advantages of punk as a covering for electrodes, and said his patients invariably found it the most agreeable covering of any employed. It had the great advantage of remaining moist for a long time.

Dr. G. Betton Massey, of Philadelphia, said that two years ago he devised an electrode made of a spiral of platinum wire enclosing a second spiral, the object of this construction being to facilitate rendering the instrument aseptic. A flat coil of No. 20 wire was in his opinion a much better basis for an electrode than gauze. If the French scale were employed, he thought it should indicate the diameter and not the circumference of the instrument.

Dr. Franklin H. Martin, of Chicago, called attention to the fact that he was the first one to invent and exhibit a spiral electrode. His instrument was first brought to the notice of the profession in 1887.

Dr. J. B. Greene, of Indiana, preferred the English to the French scale. The best material he had ever used for an electrode was moistened wood pulp; it was an excellent conductor, and so cheap that it could be thrown away after use. In his opinion it would be impracticable to fix upon standard sizes for electrodes.

A communication was read from Dr. Lucy Hall Brown, of Brooklyn, in which she recommended a special electrode made of perforated brass plate covered with punk and connected to the reophore by a peculiar spring clamp which she had devised.

On Investigation of Dr. Newman's Statistics in Urethral Stricture.

The committee, consisting of Drs. A. H. Goelet, Wm. J. Morton, and W. J. Herdman, reported that they had made a very careful and conscientious examination of Dr. Newman's records and statistics, and had asked, but unsuccessfully, for the co-operation of certain general surgeons. The committee unanimously agreed that Dr. Newman's statistics fully substantiated the claims he had made.

Afternoon Session.

Dr. Newman, of New York, read a paper on

Electrolysis in Tumours of the Bladder.

The author considered only cases of non-malignant tumours in the female bladder. If the bladder be very irritable, the preparatory treatment should consist in the careful use of medicated injections, by which means a bladder which can hardly retain 4 ounces may be made to tolerate as much as 12 ounces of fluid. For the proper use of the cystoscope it is necessary to have from 4 to 6 ounces of fluid in the bladder. The cystoscope is first used to locate the tumour, and the author advised that its use should be immediately followed by an examination with the endoscope. By means of the rubber ring, slid on to the instrument, it is easy to locate the distance of the tumour from the meatus. Indeed, he had found comparatively little difficulty in subsequently cauterising the exact spot desired. The constant current of a galvanic battery was invariably employed, and except where it was necessary to control hæmorrhage, the negative pole was the one selected. The average current strength was 10 m.a.; each sitting lasted from 5 to 15 minutes, and the intervals depended upon the result of each sitting and the condition of the patient.

There are two methods of electrolysis, general and local. General electrolysis has a specific absorbing and healing effect upon a tumour, and may be employed when the patient cannot tolerate other measures. Local electrolysis may be performed—firstly, by means of a little bulb placed in contact with the tumour; secondly, by the introduction of a platinum needle; and, thirdly, by fixation of the tumour and the introduction of a platinum needle into the tumour. The fixation of the tumour may be accomplished with the help of an instrument called the vesical tenaculum caché, and this instrument can be used as a guide to the introduction of the electrode. With this method a cannulated platinum needle is employed, which not only allows of the easy introduction of the needle, but is so arranged that the needle is projected only a certain distance beyond the end of the cannula into the tumour—a distance which can be determined beforehand by the proper adjustment of the instrument.

All the operations were done through the urethra without the employment of anæsthesia, the production of pain, or interference with the patient's occupation. The author did not wish to be understood as asserting that electrolysis would cure all benign tumours of the bladder, yet he claimed very satisfactory results in the cases which he had thought proper to subject to this treatment.

The Nutritional Effects of Statical Electricity Considered in Relation to High Frequency and High Potential Currents, and the Transparency of the Dielectric.

Dr. William J. Morton, of New York, read a paper with this title. Through the recent labours chiefly of D'Arsonval, Tesla, and Elihu Thomson, statical electricity has assumed new and important relations to electro-therapeutics. In contradistinction to the low frequency of the current obtained from the ordinary faradic coil, the high frequency high potential current is simply a periodical current, or one in which the electrical energy is cut up into many waves or periods—ten thousand to ten million per second. With this high frequency there is a correspondingly high electromotive force, and it is mainly these factors and not electrolytic conduction which is the important point to be considered when studying the electro-therapeutic effects of this current.

When a Leyden jar is suspended in connection with any electro static machine and the spark caused to pass, every time the spark

passes there is a corresponding discharge in the Leyden jar, and with each discharge oscillations take place many thousands of times a second. This is the periodical current with which we are dealing in electrostatics. The oscillations are reduced in frequency in proportion to the resistance in the circuit.

The high frequency current seems to possess an unlimited power of penetrating tissues of the body. As the static machine is set in motion and a spark passes, every particle of ether in the room is also set in motion, and the same vibration is set up in our own bodies.

According to the modern view of electricity, the electrical energy which produces what we call the current is around the wire and not in the wire, and the electrical influence is felt in the medium around the wire. If this is not a conductor then these same ether vibrations impinging on the dielectric put it in a condition of strain. The dielectric is a non-conductor having a charge, and being in relation to another body also having a charge. It is found that these periodical currents are conveyed both by our conductors and our non-conductors, and in the technical language of the present time it is said that a dielectric is "transparent" to periodic currents.

The principal object of the paper was to present the results of a series of observations which the author had made at his clinic in the New York Post-Graduate Medical School. The secretions were affected. That the circulation is visibly affected is shown by the dilatation of the cutaneous vessels following immediately upon the application of sparks locally or generally. A series of tabulated cases were shown, showing that in a great number of cases under observation, the pulse was lowered by statical electrisation from 15 to 20 beats, and that the body temperature was usually increased from a half to one degree. Stating broadly, he thought he might deduce the law that the disposition of statical electrisation is to produce an equalisation by acting upon the centres—reducing a frequent pulse and elevating a subnormal temperature, or *vice versa*.

Observations were also presented which showed that in cases of chronic articular rheumatism, this treatment resulted in greatly diminishing the quantity of uric acid, and correspondingly increasing the quantity of urea. It was also noted that many patients, while under this treatment, gained in weight very perceptibly—one patient gaining 42 lbs. in five weeks.

The author concluded by expressing the conviction that statical electrisation was only the beginning of a new and extremely important era, in which the periodical current would play a prominent part, and lead to much better practical results. The very mechanism which the author was the first to describe, and which was published in 1881, is, to-day, found to be essential for producing these wonderful electro-static effects of alternating currents.

Discussion.

Dr. H. E. Hayd, of Buffalo, said he could vouch for the statement that statical electricity profoundly affects the secretions, for he had frequently observed that it increased the specific gravity of the urine. He also knew, from personal observation, that it stimulated the circulation, and was especially useful in muscular rheumatism, owing to its power of increasing the activity of the hepatic function. He could also confirm what had been said about the increase in body weight, and in the quantity of urea excreted.

Dr. Massey referred to a recent case, in which the improved nutrition could only be attributed to the effect of the static charge.

Dr. Herdman said that the effect of statical electrisation on the circulation was sufficient to explain many of the beneficial results mentioned. He believed that in spinal irritation, and in neurasthenia, the good effects of this treatment were directly attributable to its action in relieving the passive congestion which he considered to be the fundamental cause of these affections. A few days ago Tesla admitted in his presence that his experiments with the high frequency current were the result of his attention being directed to the subject by Morton's description of his method of producing the static induced current.

Dr. Holford Walker, of Toronto, said that although his experience with statical electricity extended only over the past year, he had observed beneficial effects from its use which could only be explained by its action in increasing the circulation.

Dr. J. B. Greene, of Indiana, said that the author had not shown any marked change in the temperature as a result of statical electrisation, although claiming a marked effect on the pulse; nor had he exhibited any sphygmographic tracing from these patients. This he considered a very serious omission. His own observations had led him to believe that the good effects observed after statical electrisation were largely due to "suggestion."

Dr. W. B. Sprague, of Detroit, said, that although using one of the small static machines which had been characterised as a "toy," he had obtained gratifying results with it in cases of neurasthenia.

Dr. P. S. Hayes, of Chicago, said that his experience with statical electrisation during the past 10 years justified him in endorsing what had been said in its favour. Taking into account the high tension of statical electrolysis, he believed that the current acted directly on the contents of the cells in the tissues, and not merely on the fluids surrounding the cells.

Dr. Margaret A. Cleaves, of New York, said that she had also observed a remarkable increase of body weight in many cases. She also called attention to one very practical point, viz., that constipation of many years standing is very commonly relieved by statical electricity applied over to the lumbar and sacral plexes of nerves and to the abdominal parietes.

Dr. Morton, in closing the discussion, said that if "suggestion" were capable of uniformly affecting the pulse and temperature in the manner exhibited in his tables, it might well be adopted instead of electrical treatment. A rather intimate acquaintance with the subject of hypnotism had failed to convince him that it possessed any such remarkable power. A change of one degree uniformly in given cases he considered a "marked change."

(To be continued.)

A RECORDING TACHOMETER FOR CENTRAL STATIONS.

The regularity and quality of electricity supply may be said to vary inversely with the speed variation which is permitted to take place by the responsible chief of the staff. Owing to the practice of direct supply without the intervention of storage, the whole problem which meets the central station manager is, firstly, to so arrange the plant that a uniform speed may be obtained under normal circumstances, and, secondly, that should any variation occur from causes beyond control he may be made acquainted with the fact from inside and not be taken at a loss by the information of bad service coming from consumers in the guise of a complaint.

Of course we are aware that load and speed are to some extent related, but the changes which at present require to be made are due to the imperfect fulfilling of the laws of design by actual machines and the variations due to the internal losses which require a slight adjustment in speed to compensate for them are but small in comparison with the numeric, which represents the normal. In pumping stations, lifts, and similar cases, a record is kept of the total number of strokes made by the piston, while the speed is indicated by a tachometer or speed counter, usually of the governor ball class.

For recording speed, *i.e.*, revolutions per minute, the usual arrangement where this registration is of importance is to cause the indicating speed counter to mark on a drum the position of the pointer continuously. Breguet, Richard Fréres, and others, have made recorders on this principle for years, and many of them have fulfilled the requirements.

In cases of testing dynamo machinery, the speed is a very important factor, and a continuous record of the "revolutions per minute" must be taken by hand, or otherwise, if deductions are to be made from experimental results.

Professor Geo. S. Moler, of Cornell University, has recently designed another form of counter which gives in plain type-printed figures the speed every minute of the machine by which it is driven. At Cornell, the dynamo laboratory is supplied by power from water wheels situated several hundred feet distant at the bottom of a deep gorge. Teledynamic transmission is employed to connect the wheel-house with the college buildings, one wire cable, on large grooved sheaves, transmitting the power, and another operating the gate-hoisting apparatus. Hand regulation alone is employed, all attempts at automatic regulation have proved fruitless. Anyone who has had experience of hand regulation knows what this means. Indeed, to maintain anything like a constant speed, the regulator handle would never be at rest, but constantly opening or closing the gate, tending to check impending variations. Of course, hand regulation, say, on dynamos with constant speed, can give good results, because mechanical inertia does not come into play, and the changes in magnetising force required to make correction are so slight as not to be materially retarded by self induction or magnetic resistance.

When, however, several hundred feet of wire rope are used to transmit the alteration to the sluices and a considerable momentum has to be accelerated, it is not to be expected that even the greatest care would prevent fluctuations which could only be counteracted after they had actually altered the speed of the driven shafting and the machines in the laboratory. It is therefore necessary to continually take account of the speed in performing an experiment.

The printing tachometer is driven from the main line of laboratory shafting by chain gearing, so that the worm shaft of the counting mechanism revolves at the same rate as the main shaft. Even with the aid of diagrams it is rather difficult to follow the action of the mechanism, but the sequence of motions may be traced in the order as below described. The main parts with which we are concerned are, firstly, a toothed wheel, which is driven by the worm, taking motion from the driving shafting or machine whose speed is to be recorded, as before stated, by chain gearing. This wheel is fast on a horizontal shaft, and revolves once for every thirty revolutions of the main or tested shafting; secondly, on the horizontal shaft is, also, a type wheel, 8½ inches in diameter, made by clamping printers' type between a disc and a ring fastened with screws to one side of it; dowel pins hold the type in place, but allow of their removal in case of accident or damage. The spacing of the types correspond with the number of the teeth in the toothed wheel first described. A typewriter ribbon is employed, and the printing is done on a half telegraph tape. Thirdly, a radial plate having its centre on the horizontal shaft, carries a pin and pawl clutch, by which it may be geared fast to the toothed wheel or permitted to remain at rest.

When the speed counter is driven at the speed of the main shafting and is in use, the toothed wheel revolves at one-thirtieth of the measured speed, carrying round with it the type wheel, as the pawl causes the radial arm and the gear wheel to move together, and the radial arm catches the type wheel by a projecting pin, and drives it forward, slipping on the horizontal shaft. After one revolution of the radial arm, the pawl is released by striking against an outside pin, and the type wheel then partakes of the speed of the horizontal shaft. At the end of the minute a printing hammer is released by an electro-magnet, operated by a clock, and an impression is taken of the type opposite the paper tape at the moment. Looking at the principle upon which Prof. Moler has worked, it will be seen that for the first thirty revolutions every minute the action is to clear the last reading, bring the type wheel to its virtual zero, *i.e.*, 30, and reset the parts for the next measurement. That means that thirty is the minimum limit of range, and in the actual instrument at Cornell, the type and ratio of gearing makes 185 the maximum limit. As the type do not necessarily strike full, the fractions of one revolution can be estimated to one-fifth, fairly accurately, so that with care, the registered speed should be given correctly by inspection with limit of error of one in a thousand if the revolutions are near the higher limit of range.

In the original design it was intended to print a time mark on the tape to identify the hour at which speed readings were taken, but this has not been found necessary, and the attachment has not been built. As a rule, readings are referred to within a few minutes of their registration, and a displacement of the paper can easily be made should it be necessary to mark any particular record. The paper is fed through between 14 and 15 inches per hour, so that this distance may be used to measure back if a trial has been in progress during the absence of the experimenter.

The arrangement is decidedly ingenious, and should be capable of adaptation to many practical requirements for which its fewness of parts and direct registration renders it particularly suitable.

THE ANGLO-AMERICAN TELEGRAPH COMPANY.

THE *Financial Times*, of the 19th inst., says:—"What has happened to the Anglo-American Company, during the past few months, well exemplifies the vicissitudes to which this class of undertaking is liable, not through any fault of management, but owing to the nature of the business itself. The Anglo-American works, or rather did work till recently, four cables across the Atlantic. Three run between Valentia, Ireland and Heart's Content, in Newfoundland, and one between Brest, France, and St. Pierre and Duxburry, Massachusetts. Of these four cables two have broken down. One of the breakdowns has been that of the Brest cable, all attempts to repair which have hitherto failed; indeed, as far as can be ascertained, it appears to be so rotten that there is little hope of restoring it to working order. Although the amount of business passing over this cable is not large, it naturally formed a valuable alternative line in the event of a block or interruption on the other cables. The breakdown of the 1874 cable, one of the three lines between Valentia and Heart's Content is still more serious, and the prospects of mending it are not too bright. For three months the *Calabria*, belonging to the Telegraph Construction and Maintenance Company, has been employed on the task, and so far without success. More than once the *Calabria* has actually got the cable on board, but each time it has broken again. In order to account for the trouble experienced it is necessary to explain that the cable has parted at a spot over 2,000 fathoms below the surface of the ocean, making the task of repairing it, more especially as the cable is nearly 20 years old, one of extreme difficulty. Unless the work be completed during the next two or three weeks it will have to be abandoned until next year, as the weather will not admit of such operations being performed later. It looks, then, very much as if the company will have to go on working through the winter with two cables only, instead of four, and it becomes an open question whether it will not be compelled to lay down another. It is true that at a pinch, and during the present slackness of business, it can rub along with two cables, but it would be impossible to continue to do so permanently.

"It is here that the question of the reserve fund comes in, and the policy of the directors in preventing the fund from being trenched upon to gratify the dividend-hunger of shareholders, is fully vindicated. That it is none too high, although it stands, in round figures, at a million sterling, is shown by the chapter of accidents that has of late befallen the company. Nothing has been added to it for the last seven or eight years, and the interest accruing has mostly been used for repairs and maintenance. Now the company, as we have seen, will very likely be obliged to lay another cable; it is not impossible that it may have to put down two. In the latter case the reserve fund would be at once swept away, for the cost of laying a single cable is estimated at from £450,000 to £500,000. The expenditure would not be all loss, for the company would certainly get a new cable in exchange for the old one, but the new cable would also be liable to accidents, and in short it would be indispensable to the safety of the company that the reserve fund should be built up again. Probably an issue of debentures would have to be made, whether one or two cables were laid down, and in that case a reduction of the dividend on the preferred stock would be inevitable. It is these considerations which have in part caused the recent fall in the quotations, and they are quite sufficient to justify it. Besides this, it is well known that the Commercial Cable Company, the great rival of the Anglo-American, is about to lay down a new line, in addition to the two it already possesses. An issue of stock has been made for this purpose, and though the contract for the undertaking has not yet been signed, it only awaits the assent of the Board in New York. The Commercial Cable Company already handles 40 per cent. of the entire telegraphic traffic between this country and the States, and with greater facilities competition would be keener. Very likely there might be a rate-cutting, and a sixpenny rate would sweep away the dividend on Anglo-American preferred, as it has almost done before. We by no means desire to take an unduly pessimistic view of the situation, but none of the contingencies we have referred to are at all improbable, and one or two of them are, indeed, very likely to to happen. Our object is merely to warn investors against placing too much reliance on a stock which still stands at too high a figure, and is therefore all the more susceptible of a fall, especially under the unfavourable circumstances now prevailing."

NEW PATENTS—1893.

18,880. "Improvements in automatic electric intermittent motors for driving the mechanism of recording instruments and the like." G. W. FAIRALL. Dated October 9th.

18,894. "Improvements in standards of electromotive force." A. MUIRHEAD and J. A. L. DEARLOVE. Dated October 9th. (*Complete.*)

18,911. "Improvements in electrical contact apparatus worked by passage of railway trains." E. TYER. Dated October 9th.

18,912. "Electrical apparatus for signalling on railways." E. TYER. Dated October 9th.

18,918. "Improvements in current motors." J. WOODWARD. Dated October 9th.

18,945. "Improvements in compositions for use in telephonic transmitter circuits and in the process employed in their production." A. G. BROOKES. (Communicated by A. C. Cousens, United States.) Dated October 10th. (*Complete.*)

18,951. "Improvements in electricity meters." J. EDMONDSON. Dated October 10th.

18,970. "Combined terminal box and cut-out or fuse box." W. D. REID. Dated October 10th.

18,977. "Improvements in regulating the supply of electricity to electric glow lamps." T. B. SHARP. Dated October 10th.

18,986. "Improvements in and relating to electric motors." W. TAYLOR. Dated October 10th.

18,990. "Improvements in the method of and apparatus for electrically heating or working metal." W. P. THOMPSON. (Communicated by C. L. Coffin, United States.) Dated October 10th. (*Complete.*)

19,018. "Improvements in a system of electrical transmission." J. A. DAVIS and R. A. FOWDEN. Dated October 10th.

19,024. "Improvements in trolley supports for electric railways." J. M. ANDERSEN. Dated October 10th. (*Complete.*)

19,044. "Improvements in obtaining synchronous working of two rotating electric motors." S. PITT. (Communicated by J. H. West, United States.) Dated October 10th.

19,079. "Improvements in switches used for the proper control of electric light currents." G. J. PARFITT and G. J. T. J. PARFITT. Dated October 11th.

19,080. "Registering rifle shots on a target automatically or by electricity." A. HAGGER and S. BRAME. Dated October 11th.

19,088. "Improvements in cables for telegraphic and telephonic purposes." M. IMMISCH. Dated October 11th.

19,094. "An improved shade for oil, gas, electric, or other lights." J. F. HOYNE and G. R. STODDART. Dated October 11th.

19,102. "Improvements in and applicable to suspension-tracks for overhead cable or railway systems." W. J. BREWER. Dated October 11th.

19,112. "Improvements in electrical fittings." E. FREUND. Dated October 11th.

19,122. "A duplex electric arc lamp." C. T. PRAED and W. H. AKESTER. Dated October 11th.

19,127. "Improvements in printing telegraph systems." S. R. LINVILLE and L. F. HETTMANSPERGER. Dated October 11th. (*Complete.*)

19,145. "Improvements in apparatus for the electrolytical decomposition of brine and other liquids." H. GUTHRIE and M. GUTHRIE. Dated October 11th.

19,146. "Improvements in or relating to telephone book-holders or the like." J. F. O'BRIEN. Dated October 12th.

19,152. "Mercurial voltmeter." R. BEAVAN. Dated October 12th.

19,183. "Improvements relating to the transmission of signals through submarine and like cables, and apparatus for effecting the same." A. MUIRHEAD. Dated October 12th.

19,185. "Improvements in the diffusion and distribution of light." S. PSAROUDAKI and A. BLONDEL. Dated October 12th.

19,250. "An improved method and means for slaughtering, or killing all kinds of cattle, scientifically by electricity." E. MARSH. Dated October 13th.

19,251. "An electric indicator for use in colliery-engine houses and railway-signal cabins." C. B. CRAWSHAW and J. BATTYE. Dated October 13th.

19,283. "An electric heater." E. C. DE SEGUNDO and W. DERHAM. Dated October 13th. (*Complete.*)

19,319. "Improvements in measuring and recording instruments for electric currents." J. GRAIZIER and E. BATAULT. Dated October 14th.

19,363. "Electrical, viz., pneumatical or mechanical, apparatus for automatically indicating the names of railway stations or stopping places (and to be eventually employed for advertising purposes and indicating the time)." A. R. VON BIEBERSTEIN and E. FROST. Dated October 14th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

2,234. "Improvements in electrical switches, suitable for use in connection with electric launches and the like." C. S. SNELL and WOODHOUSE & RAWSON UNITED, LTD. Dated February 19th. Consists of a switch having four radiating double brushes, alternate sets being connected, and suitable contact plates are provided on the same face. On the other side of the base another single brush is attached to the same spindle and two contact plates are provided. The double brushes consist of two brushes of different radii, arranged

one over the other, capable therefore of making contact on two plates at different distances from the centre, and the contact plates are so arranged and formed, and the electrical connections so made, that in moving from the "off" position to either the right or the left, the accumulator battery being made up, say, in two divisions, these divisions are first placed in parallel for half speed, before they are placed in series for full speed, the single back brush making and breaking the central connections between the two divisions, whilst the double brushes make and break the parallel connections, as well as the main motor connections, and the whole system also has the functions of a reversing switch. 4 claims.

3,427. "Improvements in electric arc lamps." C. A. J. H. SCHROEDER and H. E. R. SCHROEDER. Dated February 22nd. Within a tubular carbon a thin carbon rod is fixed in such a manner that the inner solid carbon is completely insulated throughout its length from the outer tubular carbon by a layer of a suitable mass such as plaster of paris, baryta, a preparation of fossilmeal and alum, &c. One end of this new carbon electrode is conical in shape and is dipped into a conductive paste that may consist of finely divided carbon, gum arabic and water. This carbon electrode thus constructed rests or presses against an ordinary carbon rod or electrode. 7 claims.

4,494. "Improvements in electro-magnetic solenoid apparatus." F. V. ANDERSEN. Dated March 7th. In the improved solenoid apparatus the core is bent back upon itself from its centre and the solenoid or helix finds its place between the two limbs of the core, thus the electro-magnetic lines of force have a length in air which is equal to the distance between these two limbs only, and consequently an almost uniform or only slightly increasing pull is obtained on the core during the greater part of its travel inside and outside the solenoid. 3 claims.

5,988. "Improvements in or relating to apparatus for the distribution of electricity." J. S. RAWORTH and W. GEIPEL. Dated March 28th. The transformers are placed between the primary and secondary conductors as usual, but are arranged to be fed by two or more distinct primary conductors or circuits which may be connected together at the generating station or outside the generating station. By this means one or more of the primary conductors can be cut out of circuit while the secondary system is being still fed from another primary circuit or circuits. 2 claims.

6,095. "Improvements in conductors for electric railways or tramways." R. BELFIELD. Dated March 29th. The inventor employs a cable consisting of a conductor or conductors of electricity, woven, braided, knitted, plaited or manufactured in a like way, in a manner that is well understood, into a flat band so as to present a larger and more flexible surface of contact to the trolley wheel, collector, or whatever means may be used to collect the current from it, and to convey the electricity to or from the motor. 4 claims.

7,016. "Improvements in fittings of incandescent electric lamps." J. MCFARLANE and W. B. EDGAR. Dated April 12th. The inventors use one or both of contact pistons as part of the switch, and to make the make and break take place by movement of the piston or pistons. One end of the piston is brought through the insulation base of the lamp-holder, and is actuated by a small rod with projecting arm. By turning this rod the arm lifts the piston out of contact with the metal plate on the top of the glow lamp, and thus the circuit is broken. By turning the rod back again the piston is allowed to drop down and remake or complete the circuit. 2 claims.

7,252. "Improvements in electrical distributing apparatus." R. E. B. CROMPTON and W. A. CHAMEN. Dated April 14th. Consists in the use of one or more auxiliary dynamos which may be driven by the same source of motion as the main generating power or by an independent source, such as an electric motor. 4 claims.

7,361. "Improvements in the distribution of electricity by alternate currents." W. L. SPENCE and B. DEAKIN. Dated April 19th. Consists chiefly in tapping the terminal coils on the armature at two or three points before the full number of turns is reached. So that a supply at two, three or more pressures differing from one another by the required percentage is obtained. These points are connected to a series of multiple-way switches, one for each feeder (or group of feeders of the same length), by which any desired pressure may be communicated. 3 claims.

8,108. "Improvements in the manufacture of metallic articles by electro-deposition." J. W. DAVIS and J. O. EVANS. Dated April 29th. Relates more especially to the production of metallic hollow-ware articles by the electro-deposition of metal or metallic alloy, upon or within suitable cores, moulds, or matrices; but is applicable also to the manufacture of solid articles. 4 claims.

8,452. "Improvements in driving certain machines by electromotive power." A. CHAPMAN. Dated May 4th. Consists in the use of adjustable quadrants, or segmental devices attached to bearings fitted loosely on the main shaft or spindle of the drill or machine as a centre, and held firmly at a radius by studs or bolts to the body of the machine or drill, thus making it adjustable at any portion of the circle round the said shaft. The ends of aforesaid quadrants or segmental devices are produced, and a platform formed thereon on which the motor is firmly fixed. Thus always allowing the motor to keep its proper position while the drill or machine is at any angle. 4 claims.

8,638. "Improvements in electric mains." T. TOMLINSON. Dated May 6th. Relates to the employment of tubular instead of solid conductors embedded in asphalte, with their ends open to the air in manholes, across which the conductors are joined by insulated cables. By these means heat is readily dissipated. 4 claims.

10,602. "Improvements in telephonic apparatus." A. MYALL. (Communicated from abroad by W. S. Harrison, of Hong Kong.) Dated June 3rd. A battery or cell is employed in which the zinc or other electro-positive element is inserted in, or withdrawn from the exciting solution through a lever, or system of levers, actuated by taking the receiver off the hook or replacing it, or by any other method whereby the electro-positive element is inserted in the exciting solution only during the period in which a current is required through the microphone. 5 claims.

11,817. "Improvements in the means for distributing telephonic currents to theatrophones and other similar apparatus." B. MARINOVITCH and G. SZARVADY. Dated June 24th. According to one way the theatrophones are each fitted with a switch which short circuits the telephones when the apparatus is not in action. All the theatrophones are placed in series. In order to put any particular apparatus into action it is only necessary to move the switch so as to open the short circuit. 1 claim.

18,732. "Improvements in the regulating devices of alternate current arc lamps." J. S. FAIRFAX. (Communicated from abroad by Messrs. Schuckert & Co., of Nürnberg). Dated October 19th. Claim: In alternate current arc lamps, a constantly acting regulating mechanism or device having as an essential part a rotating body of metal in which a turning moment is produced by a shifting magnetic field excited by the carbon-consuming current, substantially as and for the purpose shown and described.

20,009. "A portable microphone for the improvement of hearing in deaf persons, and adapted both for individual and general conversation." F. SHAPLEY. Dated November 7th. Relates to a portable microphone consisting of a transmitter and receiver both of which communicate with a portable dry battery. The transmitters and receivers so made as to screw together and contain the necessary wire. The transmitters and receivers to be attached to movable handles; and the receivers to be attached, if preferred, to the ear by a clip (vulcanite or otherwise); or by a spring passing over the head with a pad at the other end; or another receiver for the other ear. An apparatus for general conversation consisting of a centre ornament for table or room in shape like a salad bowl which contains a complete microphone apparatus with connecting wire to the patient's receiver. 3 claims.

22,914. "Improvements in printing telegraphs." W. L. WISE. (A communication from abroad by C. L. Buckingham, of New York.) Dated December 13th. Consists of an improved telegraph system in which messages are automatically transmitted through the medium of strips of perforated paper, and received by a printing machine in Roman or other typographical characters, the transmission whether one or more, for each character of a message, being effected within the time required to single impulse over the main line. 21 claims.

22,915. "Improvements in printing telegraphs." W. L. WISE. (Communicated from abroad by C. L. BUCKINGHAM, of New York.) Dated December 13th. The object of the invention is to reproduce messages in print, as rapidly as they have heretofore been recorded in dots, dashes, and spaces by the Wheatstone or other similar methods, and by the employment of only about the same number of main line pulses. 18 claims.

22,931. "Improvements in printing and multiple synchronous telegraphs." W. L. WISE. (Communicated from abroad by C. L. BUCKINGHAM, of New York.) Dated December 13th. Relates to the application of a printing telegraph to a multiple synchronous or synchronous multiple system of telegraphy, and consists in the combination with the multiple synchronous system of an automatic transmitter, a printing instrument in which the type-carrying device, like a type-wheel, is controlled by a series of adjusters operating singly or in various combinations to set the type-wheel to the required different positions, the magnets which operate on said adjusters at the receiving stations being controlled by bringing them successively into connection with the main line through the branches of the multiple synchronous telegraph apparatus. 15 claims.

22,950. "An improved galvanic dry battery or cell, and a composition for use in such cells. R. HADDAN. (A communication from abroad by R. Gabarro, of Barcelona.) Dated December 13th. Claims:—1. A galvanic dry cell consisting of an outer vessel of zinc, a layer of wax or equivalent insulating material in the base thereof, a central hollow or solid electrode of carbon in said vessel, a composition or combination of two compositions between the carbon and zinc and a sealing of resin or equivalent insulating material filling the upper part of said vessel. 2. In a galvanic dry cell, the composition consisting of the material described in, or approximately in, the proportions specified.

23,919. "Improvements in and relating to electrolytic apparatus." T. CRANEY. Dated December 27th. Claim:—The combination with an electrolytic apparatus comprising a plurality of electrolytic cells connected to permit the solution to pass successively from one to the other for the frictional decomposition of the solution passing from one into the other of an electric generator, anodes and cathodes connected in multiple arc in the circuit of said generator, and a graduated resistance in the circuit of each electrolytic cell, substantially as described.

23,906. "Improvements in incandescent lamps for electric lighting." F. H. PRENTISS. Dated December 27th. Consists in constructing the lamp so as to facilitate the repairing of the same by the substitution of a new filament in the place of a burned out or broken filament, without the destruction of the lamp; and also in providing the lamp with a detachable cap which may be readily removed when it is desired to repair the lamp, or for any other reason. 9 claims.

24,147. "An improved automatic circuit closer for telegraph keys." C. W. BRADFORD. Dated May 31st. (Under International Convention.) Relates to an improvement in telegraph keys, its object being to construct a telegraph key in such manner that the liability of accidentally leaving the circuit open, incident with keys of ordinary construction, will be effectually avoided. 2 claims.